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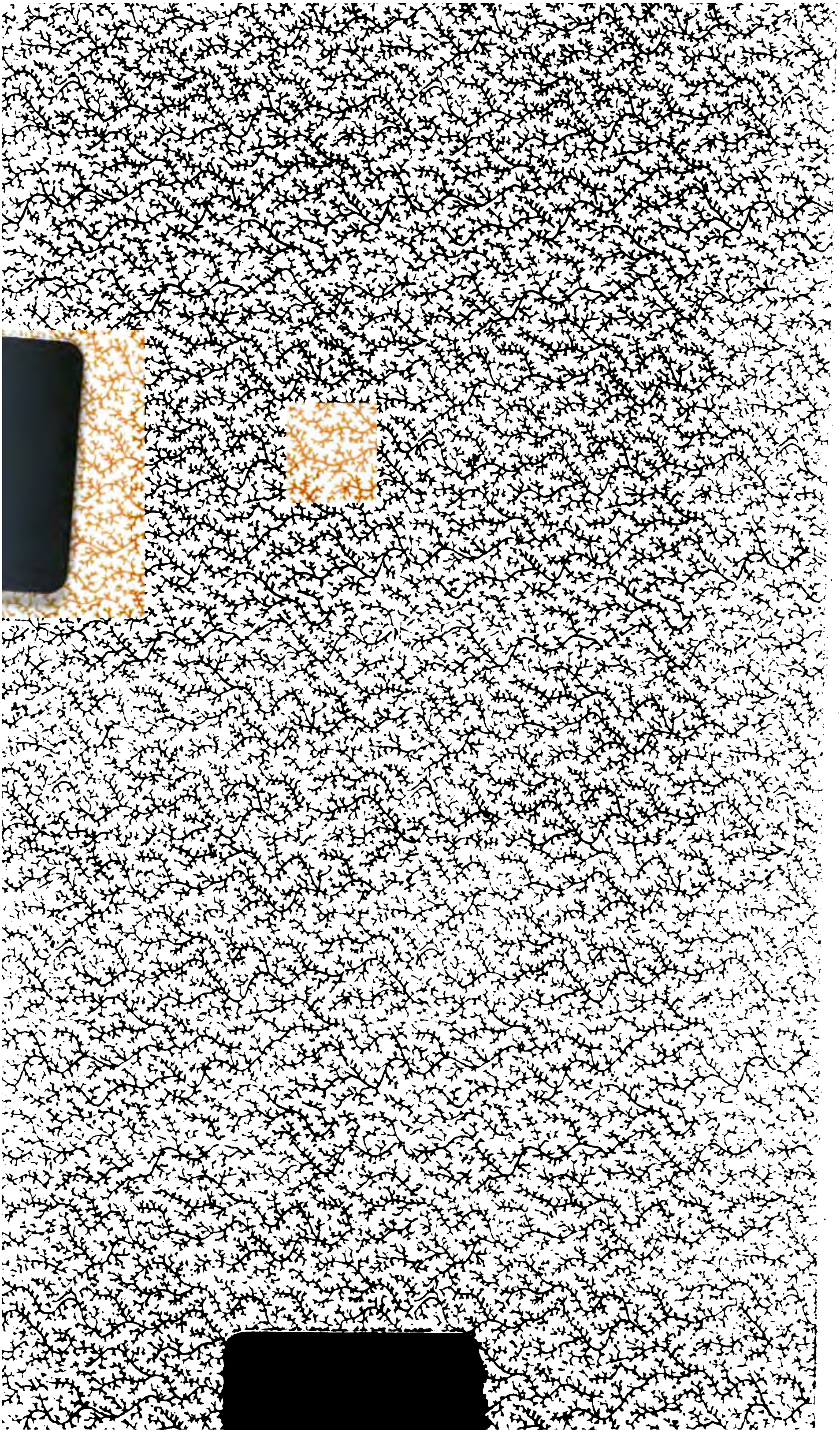

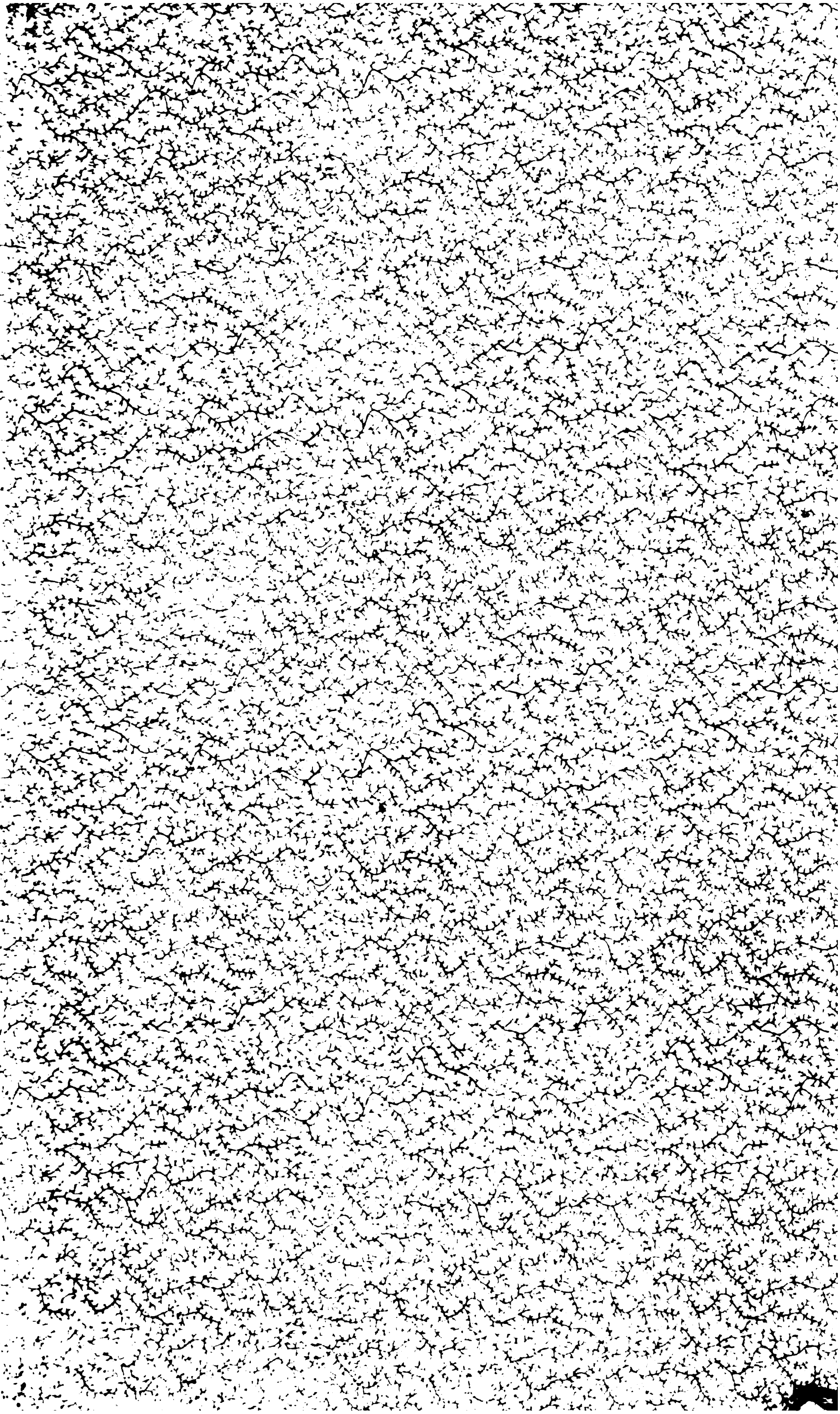

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Education Department Bulletin

Published fortnightly by the University of the State of New York

Entered as second-class matter June 24, 1908, at the Post Office at Albany, N. Y., under the act of July 16, 1894

No. 490 ALBANY, N. Y. MARCH 1, 1911

New York State Museum

JOHN M. CLARKE, Director
EPHRAIM PORTER FELT, State Entomologist

Museum Bulletin 147

New York State.

26th REPORT OF THE STATE ENTOMOLOGIST

ON

INJURIOUS AND OTHER INSECTS

OF THE

STATE OF NEW YORK

1910

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UNIVERSITY OF THE STATE OF NEW YORK

1911

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STATE OF NEW YORK

EDUCATION DEPARTMENT

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New York State Education Department
Science Division, December 21, 1910

Hon. Andrew S. Draper LL.D.
Commissioner of Education

DEAR SIR: I have the honor to communicate herewith for publication as a bulletin of the State Museum the Annual Report of the State Entomologist, for the fiscal year ending September 30, 1910.

Very respectfully
JOHN M. CLARKE
Director

STATE OF NEW YORK
EDUCATION DEPARTMENT
COMMISSIONER'S ROOM

Approved for publication this 22d day of December 1910

A. S. Draper

Commissioner of Education

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JOHN M. CLARKE, Director

EPHRAIM PORTER FELT, State Entomologist

Museum Bulletin 147

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26th REPORT OF THE STATE ENTOMOLOGIST, 1910

To John M. Clarke, Director of Science Division

I have the honor of presenting herewith my report on the injurious and other insects of the State of New York for the year ending October 15, 1910.

The past season has been remarkably quiet so far as unusual outbreaks of injurious insects are concerned. The entomologist was exceptionally fortunate in discovering a colony of pedogenetic larvae, presumably those of Miastor americana. These extremely peculiar forms were previously unknown in this country and have been studied by only a few Europeans. A summarized account of these interesting larvae is given in an appendix.

Fruit tree pests. The experimental work with the codling moth was continued the present season under more diverse conditions, and data which will be of great value in the practical control of this species, was secured. The experiments were conducted in the orchards of W. H. Hart, Poughkeepsie; C. R. Shons, Washingtonville and William Hotaling, Kinderhook. Great pains were taken to secure an ample number of trees likely to produce a nearly uniform amount of fruit. Each plot, as last year, except in the case of Mr Hotaling's orchard, consisted of 42 trees, the fruit from the central six alone being counted. Comparisons were made to ascertain the relative efficacy of one spray given just after the blossoms dropped, with this treatment supplemented by a second application about three weeks later. The unusual abundance of the codling moth the past season renders the data secured of exceptional value because they show the possibilities under very adverse conditions. Assistant State Entomologist Young aided in the field work and was responsible in large measure for the computation of the tabulated data. These experiments and their application are discussed on subsequent pages.

The San José scale is still very destructive, especially to peach trees, though our progressive orchardists have comparatively little difficulty in controlling it. A lime-sulfur wash, particularly that known as the concentrated wash, either homemade or commercial, has proved very satisfactory, as a rule, in checking this pest. There was complaint of injury by the cherry maggot in the Hudson valley and an investigation of the pest and methods of controlling it was inaugurated. The cherry and pear slug was exceptionally abundant in this region and also in the western part of the State. The pear psylla was somewhat numerous in the lower Hudson valley and reports of serious injuries were received from certain sections in the western part of the State.

The work of a new apple pest which may be known as the lined red bug (Lygidea mendax Reut.) was observed in the Hudson valley. This insect occurs in early spring, lives upon the more tender terminal leaves and, under favorable conditions, may inflict considerable injury.

Shade tree pests. The injurious work of various species has been brought to our notice. The more important of the shade tree pests is the elm leaf beetle, a well known form which has been exceedingly abundant on Long Island, throughout the Hudson valley and in certain cities in the western part of the State. The sugar maple borer has been unusually numerous on the trees of Fulton, Oswego county, destroying or practically ruining a number of magnificent trees. The cottony maple scale has been somewhat abundant in the lower Hudson valley, while the injurious work of the false maple scale was observed in several localities in the vicinity of New York city.

Forest insects. The snow-white linden moth, a pest which has been very destructive in the Catskills for the past three years, was abundant in limited localities last season and its flight in small numbers was observed in various places. A series of outbreaks by another leaf feeder was reported from several localities. They were due to the operations of a green, white-striped caterpillar

(Xylina antennata) frequently designated as the green fruit worm. The destructive work of the hickory bark beetle, noted in a preceding report, has been continued. An unusual outbreak was that of Abbott's sawfly, a false caterpillar which stripped or nearly defoliated many white pines in the foothills of the Adirondacks. The spruce gall aphid has continued to be abundant and injurious on Norway spruce, in particular. It is interesting to record the discovery of another species of gall aphid, new to the State, occurring upon the Colorado blue spruce. The above noted insects have been the subject of correspondence and, in some instances, of field investigations during the past season.

Gipsy and brown tail moths. Much interest was aroused early in 1909 by the finding of thousands of winter nests of the brown tail moth on many shipments of French seedlings. A number of such nests occurred on shipments received in 1910, though the pests were not so abundant as during the preceding year. The careful inspection of the stock appears to have prevented this insect from becoming established in the State. There is much more danger of this moth being brought into New York State on shipments of full grown nursery stock originating in infested American territory than there is of its being introduced with imported seedlings. It has been found necessary to give considerable time to the determination of remains of caterpillars, cocoons and egg masses in order to be certain that none of these fragments on nursery stock indicated the presence of either the gipsy or brown tail moth. The mounting of such fragments has devolved upon Miss Hartman.

A personal investigation of conditions in eastern Massachusetts shows that no pains are being spared to prevent the dissemination of either the gipsy or the brown tail moth. Particular attention has been given to keeping the property abutting on the principal highways free from the pests so as to eliminate in large measure the danger of their being carried by vehicles of any kind. There has been, however, some extension of the territory occupied by these two pests. The gradual spread of these insects appears to be inevitable, though the utmost care is taken in the treatment of the outlying colonies. It is gratifying to state that the serious infestation recently discovered at Wallingford, Conn. has been handled in such a satisfactory manner that only a very few specimens rewarded a week's careful search by a gang of fifteen men. An examination of the work with parasites showed that no stone was being left unturned in an effort to find, rear and liberate a large number of efficient enemies of these pests. The entomologist would emphasize once more the grave danger of bringing either one or both of these pests into the State on nursery stock originating in the infested area, and would call attention to the great desirability of promptly exterminating any isolated colonies which might be found in the near future.

House fly. The popular interest in the control of this pest has continued and bids fair to result in important and far-reaching sanitary changes. The demand for information along these lines speedily exhausted the edition of Museum Bulletin 129 on the *Control of Household Insects* and necessitated its republication in an extended and revised form as Museum Bulletin 136 entitled: *The Control of Flies and Other Household Insects.* The entomologist has been called upon to give a number of popular lectures upon this insect and has made personal examinations of conditions in several localities, giving special attention to situations favorable for the production of flies in cities and villages.

Gall midges. Our studies of this extensive and interesting group have been continued and the results are now in manuscript. This publication will describe fully some 800 species, 441 having been reared. The tabulation of midge galls, made with the assistance of Miss Hartman, shows that we know some 538 species representing 44 genera and living at the expense of some 177 plant genera referable to 66 plant families. In addition to the above, there are some 5 species reared from unknown plants and 11 species belonging to 3 genera known to be zoophagous.

A number of new species have been reared during the year. Miss Cora H. Clarke of Boston, Mass. has continued collecting and forwarding to us excellent series of galls from which we were able to rear several previously unknown species. The care of this material has devolved largely upon assistant D. B. Young and Miss Hartman. The latter has also made a large number of microscopic mounts of these fragile forms.

Miscellaneous. The entomologist spent nearly six weeks in Europe, giving special attention to museum methods, shade and forest tree insects and the gall midges. Collections were studied in the following institutions: British Museum of Natural History, London; the Universities of Oxford and Cambridge; the Tropical School of Medicine, Liverpool; the zoological gardens at Antwerp; the Royal Museum of Natural History at Brussels; the botanical gardens of Ghent; Museum of Natural History and also the entomological station, both of Paris; the University at Zurich; the exceptionally valuable collection of forest insects in the forestry school at Munich; the natural history collections in the Senckenberg Museum at Frankfurt; the Winnertz collections in the University of Bonn; the Museum of Natural History, Berlin, and the Museum of Natural History at Hamburg. In addition, the entomologist spent several days with Prof. J. J. Kieffer of Bitsch, Germany, studying his exceptionally valuable collection of Cecidomyiidae, and a day with Prof. E. H. Rübsaamen at Remagen, Germany, which was devoted largely to examining his numerous excellent drawings and a discussion of the classification of this group. A portion of a day was spent with Oberforster H. Strohmeyer of Münster, Germany, studying his excellent collection of Scolytidae, while another day was passed with Oberforster Karl Philip at Sulzberg obtaining first-hand information of forestry methods as practised in Germany.

Publications. Numerous brief, popular accounts dealing with injurious insects have been prepared by the entomologist for the agricultural and local press, besides a few more technical papers for scientific publications. A revision of Museum Bulletin 129, as noted above, was issued during the year, while the report for 1909 appeared July last. A tabulation of the midge galls known to occur upon several plants was published in August under the title of *Gall Midges of Aster, Carya, Quercus and Salix.*

Collections. A most valuable addition to the collections was secured through the generosity of Prof. J. J. Kieffer, of Bitsch, Germany, who kindly donated to the museum a number of his generic types of European gall midges. These have been carefully mounted and are now accessible to students in the group. A fine series of Italian midge galls was secured by exchange with Dr Mario Bezzi. These were carefully arranged and labeled by Miss Hartman. Miss Cora H. Clarke, as in preceding years, has contributed some valuable biological material, mostly insect galls.

The arrangement and classification of the collection has been pushed as rapidly as possible, though it should be remembered that, with the limited office staff, it is practically impossible to keep the collections properly classified, while the securing of extremely desirable additional material must of necessity proceed slowly. The restrictions due to a small staff will become more apparent with the occupancy of quarters in the new building, accompanied by the obligation of maintaining a larger exhibit. The school teachers of localities are ma

connection with

Department to

the State

other matters during the absence of the entomologist in Europe and while away on vacation. Miss Hartman, in addition to matters noted above, has rendered material assistance in bibliographic work and in translating from German, French and Italian works. Numerous specimens have been received during the year for identification and many inquiries made concerning injurious forms. 1445 letters, 37 postals, 417 circulars, 1475 packages were sent through the mails and 44 packages were shipped by express.

General. The work of this office has been greatly facilitated, as in past years, by the identification of certain species through the courtesy of Dr L. O. Howard, chief of the Bureau of Entomology, U. S. Department of Agriculture, and his associates. Several correspondents have aided materially in securing valuable specimens of one kind or another, and, as heretofore, there has been a most helpful cooperation on the part of all interested in the work of this office.

Respectfully submitted
EPHRAIM PORTER FELT
State Entomologist

Office of the State Entomologist, October 15, 1910

Albany, Troy and presumably other near-by localities are making extensive use of our exhibit collections in connection with the regular school work. It is the aim of the Department to have a representative collection of the species occurring in the State, though the assembling of such means the work of years.

The nearly completed monograph on the gall midges shows that the State collections in this family will far exceed anything that can be assembled elsewhere for some years to come. It will always be exceptionally valuable because of the very large series of generic types or cotypes. Assistant State Entomologist Young has identified and arranged the Conopidae, besides doing much miscellaneous work in classifying insects collected during the year and identifying species sent in for name. A number of Hemiptera have been very kindly determined by our well known authority in this group, Mr E. P. Van Duzee of Buffalo. Miss Hartman has also assisted in the arrangement of the collection and has reared and spread a number of specimens.

The value of the exhibit collections will be greatly enhanced when the fine series of plant groups, designed for the exhibition of insects in their natural environment in the new Educational Building, has been completed. The wax work for four of these groups has been delivered and it is planned to complete the remainder next year. Several excellent models representing injurious insects are now on exhibition and more should be secured, preferably made to order, since only a few can be purchased in the market, while no one has attempted to prepare models of many forms which could be exhibited in this manner to very great advantage.

Nursery inspection. There has been close cooperation with this phase of the work conducted by the State Department of Agriculture. Numerous specimens of both native and foreign insects have been submitted to this office for name, and the entomologist frequently consulted in regard to various problems. This work, while consuming much time and often necessitating identifications of minute forms, like scale insects or the recognition of species by fragments or the comparatively unknown early stages, is very important, since the treatment of large shipments must depend in great measure upon our findings.

Office matters. The general work of the office has progressed in a satisfactory manner, the assistant State entomologist being in charge of the office and responsible for the correspondence and other matters during the absence of the entomologist in Europe and while away on vacation. Miss Hartman, in addition to matters noted above, has rendered material assistance in bibliographic work and in translating from German, French and Italian works. Numerous specimens have been received during the year for identification and many inquiries made concerning injurious forms. 1445 letters, 37 postals, 417 circulars, 1475 packages were sent through the mails and 44 packages were shipped by express.

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Respectfully submitted
EPHRAIM PORTER FELT
State Entomologist

Office of the State Entomologist, October 15, 1910

INJURIOUS INSECTS

CODLING MOTH

Carpocapsa pomonella Linn.

The apple worm, or larva of the codling moth, is such a common pest that comparatively few appreciate the losses caused by its operations, and altogether too many regard it as a pest which it is almost useless to combat. This latter notion is a very erroneous one. There is abundant data to prove not only the possibility, but the practicability, of controlling this insect in a very satisfactory manner. This is shown in a very striking way by the experiments conducted last year. Even one thorough application resulted in the production of nearly 99 per cent of worm-free fruit, while check trees did not produce quite 73 per cent of sound fruit. These experiments were continued the present season for the purpose of testing more thoroughly and under varying conditions the relative value of one or more sprays for the control of this serious pest.

General observations. The season of 1910 has been remarkable for the development of a large second brood and a consequent prevalence of wormy apples. The work of this pest was very evident in Genesee county as well as in the Hudson valley, and in some unsprayed orchards over 50 per cent of the fruit had been injured by the apple worm. May 30th there was a severe hail storm in sections of the Hudson valley, and an examination of the wormy fruit showed that from 50 to 60 per cent of the apple worms had entered at points injured by the hail. Cacoecia larvae were rather prevalent in one orchard and their operations were very frequently followed by codling moth larvae entering at such places. Moreover, badly rusted, rough spots on the fruit were also favorite points of attack. Comparative freedom from codling moth injury was observable in orchards where pigs or sheep had been allowed to run, this being especially true if the animals had been pastured in the orchards for several years, even in those where there was no spraying. One codling moth larva was found spun up in a slight depression on the under side of an apple resting on loose soil, and another had prepared a similar retreat for the winter on an apple before it had dropped from the tree.

Life history and habits. Before discussing the experimental work of the season we will briefly summarize the life history of this species. The apple worm, as is well known, winters in a tough, silken cocoon, usually found under the rough bark of trees. The advent of warm weather in spring, which in New York means late April and early May, is followed by the caterpillars transforming within their silken retreats to pupae, and a week or ten days after the blossoms drop the moths commence to emerge and continue to appear throughout the greater part of June. The minute, whitish eggs are deposited largely upon the leaves, though a number may be found on the young fruit. These hatch in about a week and as a consequence the young apple worms of the first brood may be entering the small apples from early in June to nearly the end of the month, or even later. The caterpillars require about four weeks to complete their growth, at which time they desert the fruit, wander to a sheltered place, spin a cocoon, transform to pupae and in about two weeks, namely the very last of July or in August, another brood of moths appears. These in turn deposit eggs which hatch in due time and the young larvae usually enter the side of the fruit. Two broods appear to be the rule in the northern fruit-growing sections of the United States, though some investigators claim a third in the southwest.

Experimental work. It was planned the present season to test, under varying conditions, the relative efficacy of but one spray given just after the blossoms fall, compared with other plots where the application just described was followed by a second about three weeks later, designed to destroy the codling moth larvae just as they are hatching, and a third plot where but one spraying was given about three weeks after the blossoms fell. This plot was designed to show the relative efficacy between the treatment at this time, which is markedly out of season, and the time applications are usually made, namely just after the bloom falls.

Series 1. This series of experiments were conducted in a young orchard belonging to Mr W. H. Hart of Arlington, near Poughkeepsie and close to Briggs Station on the Hopewell branch of the Central New England Railroad. The orchard is on a moderately high hill, the trees being thrifty, about 16 years old, 16 to 19 feet

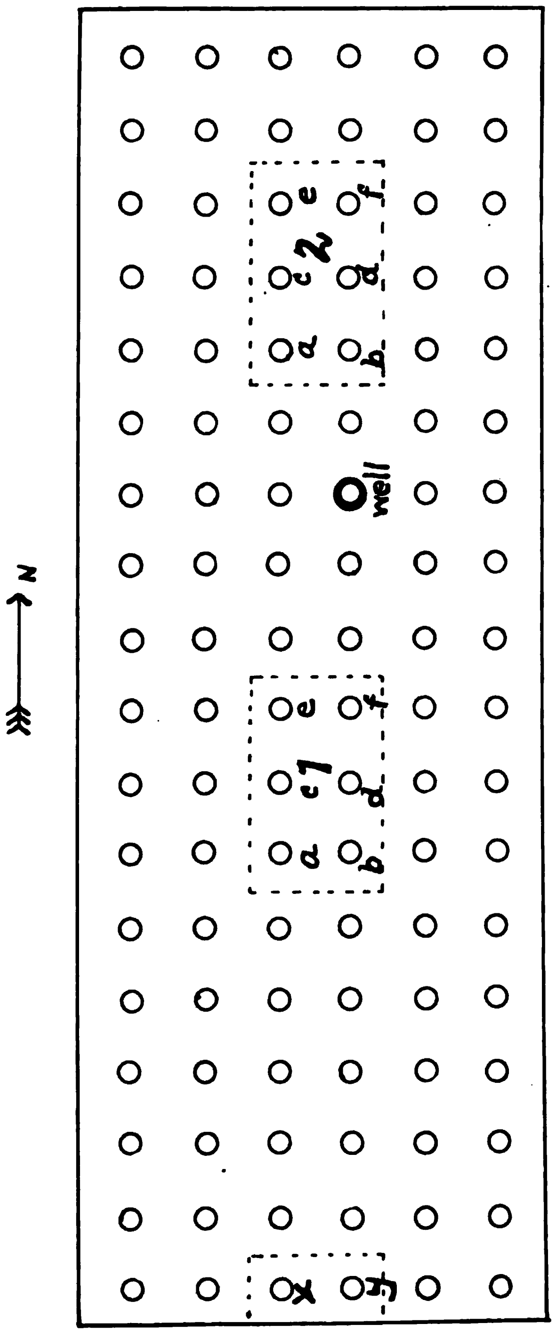

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Fig. 1 Portion of orchard at Arlington showing the location of the experimental plots

high and 30 feet apart. The actual experimental trees were northern spy. Each plot consists of 42 trees, six trees in a row one way and seven in a row the other way, the central six being the actual experimental trees. These were carefully selected for uniformity in size, fruitage and infestation. There was a large crop of Baldwin apples in this orchard last year and some of the northern spys produced a fair yield. The check trees of the two plots in this orchard were located in the same north and south rows of trees near the western edge of the orchard, and were some little distance north of the road. Plots 1 and 2 were still further north. These two plots were thoroughly sprayed May 12, 1910 with seven pounds of arsenate of lead (15 per cent arsenic oxide) to each 150 gallons of spray, together with one gallon of a homemade concentrated lime-sulfur wash (Cordley formula, testing probably from 30 to 31° Baumé) to each 25 or 30 gallons of spray. The day was dry, nearly quiet and conditions were almost ideal. The pressure was maintained at from 100 to 150 pounds, Friend nozzles being employed and 150 gallons of spray sufficing for about 105 trees. All of the spraying was from the ground, the hose being tied to poles and the nozzles set at an angle so as to discharge almost directly into all the blossoms. The application was sufficiently thorough to cover practically all of the foliage in a very uniform manner. The trees were fairly well fruited and had just completed blossoming.

The second application was made on plot 2 June 2d. The day was cloudy, with a strong southwest wind and, as a consequence, the spray was applied from only one side, the eastern portion of the trees not being well covered, though special attention was given to the center where the greater portion of the fruit was located. The formula for the spray was practically the same as in the preceding application; 140 gallons were necessary to spray the plot of 42 trees. The fruit was in fine condition and the foliage had made excellent growth since the earlier application, which was plainly evident. At this time there were no signs of codling moth work.

An examination of this orchard June 30th showed a very gratifying condition. The check trees were in excellent foliage and already exhibited a markedly greater codling moth infestation. Plot 1, which received but one spraying, showed practically no wormy fruit and no signs of injury to the foliage. The same was true of plot 2 which was sprayed twice.

The fruit was picked up from under these trees and carefully classified August 23d and September 12th, the remainder being picked October 6th. The condition of the fruit on this latter date was most excellent, the color being fine, the surface smooth and a very high percentage with few defects. A tabulation of the entire data is given below.

Series 1, plot 1

TREE	DATE	TOTAL FRUIT	CLEAN FRUIT		WORMY FRUIT						
			Total	%	Total	%	End wormy	End and side wormy	Side wormy	Exit hole 1	Exit hole 2
A	Aug. 23........	9	6	....	3	....	......	......	3	3	.....
	Sept. 12........	6	4	....	2	....	......	......	2	2	.....
	Oct. 6..........	148	135	....	13	....	......	3	10	3	1
		163	145	88.95	18	11.05	......	3	15	8	1
B	Aug. 23........	1	1	....	......	....	......	......	......	.....	.....
	Sept. 12........	8	5	....	3	....	......	......	3	3	.....
	Oct. 6..........	105	99	....	6	....	1	2	3	2	1
		114	105	92.10	9	7.90	1	2	6	5	1
C	Aug. 23........	12	4	....	8	....	......	1	7	7	.....
	Sept. 12........	22	13	....	9	....	......	1	8	9	.....
	Oct. 6..........	409	382	....	27	....	5	7	15	6	.....
		443	399	90.07	44	9.93	5	9	30	22	.....
D	Aug. 23........	14	7	....	7	....	......	......	7	7	.....
	Sept. 12........	20	13	....	7	....	3	......	4	6.	.....
	Oct. 6..........	593	563	....	30	....	1	2	27	3	.....
		627	583	92.98	44	7.02	4	2	38	16	.....
E	Aug. 23........	5	1	....	4	....	......	......	4	4	.....
	Sept. 12........	6	6	....	......	....	......	......	......	.....	.....
	Oct. 6..........	160	139	....	21	....	4	3	14	5	1
		171	146	85.38	25	14.62	4	3	18	9	1
F	Aug. 23........	12	3	....	9	....	......	......	9	8	.....
	Sept. 12........	11	8	....	3	....	......	......	3	3	.....
	Oct. 6..........	298	275	....	23	....	2	2	19	12	.....
		321	286	89.09	35	10.91	2	2	31	23	.....
	Grand total...	1839	1664	90.48	175	9.52	16	21	138	83	

Series 1, plot 2

TREE	DATE	TOTAL FRUIT	CLEAN FRUIT		WORMY FRUIT						
			Total	%	Total	%	End wormy	End and side wormy	Side wormy	Exit hole 1	Exit hole 2
A	Aug. 23	12	11	......	1	......	......	......	1	1	....
	Sept. 12	9	9	......	......	......	......	......	......	......	....
	Oct. 6	441	414	......	27	......	4	......	23	3	....
		462	434	93.93	28	6.07	4	......	24	4	....
B	Aug. 23	3	2	......	1	......	......	......	1	1	....
	Sept. 12	5	3	......	2	......	......	......	2	2	....
	Oct. 6	362	347	......	15	......	......	......	15	4	....
		370	352	95.14	18	4.86	......	......	18	7	....
C	Aug. 23	2	1	......	1	......	......	......	1	1	....
	Sept. 12	9	8	......	1	......	......	......	1	......	....
	Oct. 6	218	215	......	3	......	1	......	2	......	....
		229	224	97.81	5	2.19	1	......	4	1	....
D	Aug. 23	12	7	......	5	......	......	......	5	5	....
	Sept. 12	14	12	......	2	......	......	......	2	2	....
	Oct. 6	954	941	......	13	......	1	......	12	4	....
		980	960	97.95	20	2.05	1	......	19	11	....
E	Aug. 23	7	5	......	2	......	......	......	2	2	....
	Sept. 12	4	4	......	......	......	......	......	......	......	....
	Oct. 6	365	358	......	7	......	......	......	7	4	....
		376	367	97.60	9	2.40	......	......	9	6	....
F	Aug. 23	2	2	......	......	......	......	......	......	......	....
	Sept. 12	27	24	......	3	......	......	1	2	2	....
	Oct. 6	400	393	......	7	......	......	......	7	2	....
		429	419	97.67	10	2.33	......	1	9	4	....
	Grand total	2846	2756	96.84	90	3.16	6	1	83	33	....

Series 1, check trees

TREE	DATE	TOTAL FRUIT	CLEAN FRUIT		WORMY FRUIT						
			Total	%	Total	%	End wormy	End and side wormy	Side wormy	Exit hole 1	Exit hole 2
X	Aug. 23	68	10	......	58	......	30	20	8	35	13
	Sept. 12	17	......	......	17	......	9	4	3	9	.....
	Oct. 6	36 19	4 82	......	32 37	......	4 20	15 14	13 3	19 18	5
		240	96	40	144	60	63	53	27	81	18
Y	Aug. 23	88	6	......	82	......	42	25	15	60	7
	Sept. 12	53	3	......	50	......	20	19	11	36	4
	Oct. 6	75 255	1 96	......	74 159	......	10 51	51 92	13 16	43 78	7 4
	Grand total	471	106	22.5	365	77.5	123	187	55	217	22

Average for X-Y....................28.41........72.59

A study of the above tables discloses several very interesting facts. In plot 1 there is not a very wide variation in the fruitage, the number of apples ranging from 114 in tree B to 627 in tree D. The percentage of sound fruit varies from 85.38 per cent in tree E, with its 171 apples, to 92.98 per cent in tree D, having a maximum yield of 627 apples. Note that tree B had only 9 wormy fruit, nearly 8 per cent of the 114 produced, while the most wormy apples were found on trees C and D, each with 44 and forming, respectively, 9.93 and 7.02 per cent of the total product. Here, at least, the percentage comparison is obviously unfair, since the two trees had, as nearly as we can determine, a practically uniform infestation, yet the percentage varies considerably, due simply to the larger crop on one tree. There were no end wormy only on tree A, while the maximum in this classification was 5 on tree C. The side wormy range from 40 in tree D to 8 in tree B. It is perhaps significant that 8.6 per cent of the total fruit in this plot was side wormy, 7.5 per cent of this being side wormy only.

Plot 2 with its second poisoned application produced approximately 6 per cent additional sound fruit. This is nearly half a barrel, or 171 apples. It is probable that the somewhat greater yield of this plot, namely 2846 as compared with the 1839 of plot 1, had its influence in the production of a somewhat larger percentage of sound fruit. It is interesting to note certain details. The minimum tree C, with only 229 apples, produced 97.81 per cent of sound fruit, while the maximum tree D, with 980 apples, yielded 97.95 per cent of sound fruit, a difference of only .06 per cent. Here again we see the obvious injustice of a strictly percentage comparison, since C yielded only 5 wormy apples while D had 20, or, in other words, supported four times as many codling moth larvae, yet, owing to the disparity in fruiting, the percentage was practically identical. The minimum percentage of sound fruit was 93.93 produced by tree A yielding 462 apples, 28 of which were wormy. The minimum number of wormy apples, five, was produced by tree C mentioned above. The number of end wormy only ranges, among the individual trees, from nothing to 4, a total of 6 for the plot, with only 1 end and side wormy. It will be seen at once that only a little over 3.3 per cent of the apples in this plot were either side or end and side wormy, or a reduction in the number of side or end and side wormy of nearly 6.3 per cent from that of plot 1, by far the greater number being side wormy only. The gain following this second application is apparent in the almost total elimination of end wormy fruit and the material reduction in the side wormy, the actual number being nearly one-half that in plot 1.

The two check trees, X and Y, yielding respectively, 240 and 471 apples, a total of 711, 72.59 per cent being wormy, give an excellent idea of the conditions which would have prevailed had there been no application of poison. They produced respectively, only 40 per cent and 22.5 per cent of sound fruit and totals of 144 and 365 wormy apples, 80 of these on X and 242 on Y, or 33 per cent and 51 per cent respectively, of the total yield being side wormy. There were only 28.41 per cent of sound fruit on the two trees. It will be seen that under natural conditions, such as obtained last year, approximately equal numbers were end and side wormy.

Series 2. This series of three plots and two check trees was laid out in the young orchard of Mr C. R. Shons at Washingtonville. These trees are about 18 years old, 16 or 18 feet high, thrifty, rather thickly set and with a steep incline just southeast of the experimental area. The three plots and the check trees, as will be seen by reference to figure 2, were all in the same row of trees, running approximately northeasterly and consisted so far as the experimental trees were concerned, with but one exception, of Baldwins. The two check trees were farthest from the highway. The experimental trees in this series, as in the preceding, were carefully selected so as to obtain, as far as possible, uniformity in fruitage and infestation. Plots 1 and 2 were thoroughly sprayed May 11th with arsenate of lead and bordeaux mixture. The first tank of 150 gallons contained 6 pounds of arsenate of lead (15–16 per cent arsenic oxide). This was applied to the actual experimental trees and the barrier trees, spraying them together with a few trees on the northeast corner of plot 2. The second tank contained 6 pounds of arsenate of lead and was put on the remaining barrier trees on the north side of plots 1 and 2 and also on a portion of the barrier trees on the southeast corner of plot 2. The remainder of the barrier trees, namely, those on the southwest corner of plot 2 and the southern ones on plot 1, were sprayed with 2 pounds of arsenate of lead and 1 pound of paris green to 150 gallons, in con-

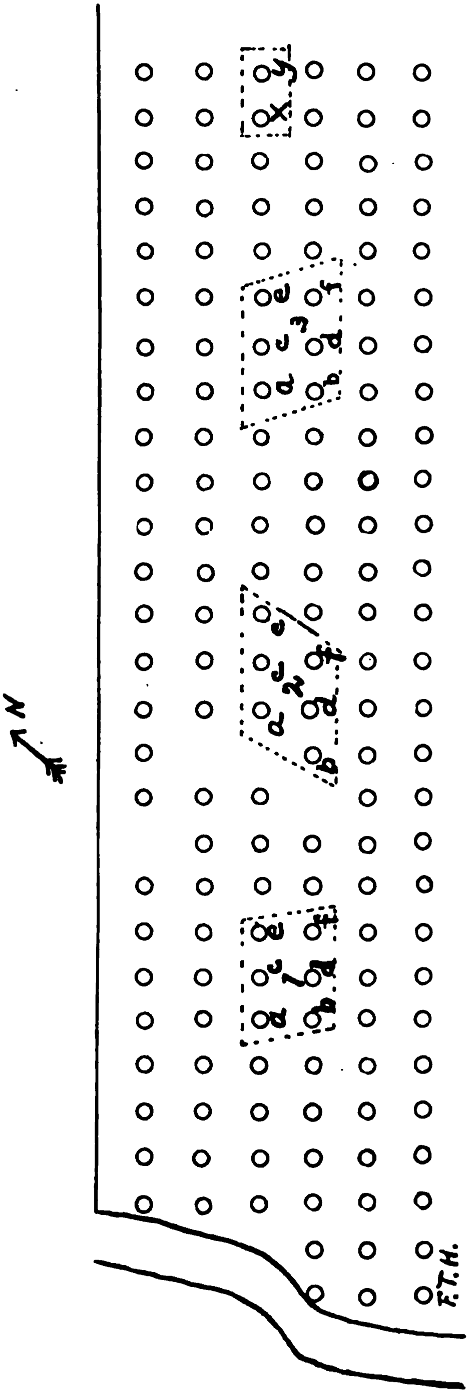

Fig. 2 Portion of orchard at Washingtonville showing the location of the experimental plots

nection with the bordeaux mixture. This latter consisted approximately of eight pounds of copper sulfate with enough lime to satisfy the copper, to 150 gallons.

The day was lowery with an occasional sprinkling of rain, but at no time did enough water fall to materially affect the work. The pressure was uniformly maintained at 85 to 100 pounds, a one horse gasolene engine supplying the power. Friend nozzles were employed, set at an angle and on the end of long extension nozzles, one man standing in a wagon, thus being able to throw the spray down upon even the highest blossoms. The actual experimental trees and the barriers separating them were Baldwins, while the two rows of barrier trees on the northwest were Wagners, and the same was true of the first barrier row on the southeast, the second being Baldwins. The blossoms had just dropped from the trees and the time of application was therefore nearly ideal.

Plot 2 was sprayed a second time June 1st and plot 3 for the first time on the same date. The day was cloudy with an occasional mistiness which did not interfere with the work, as there was not at any time enough moisture to wet the foliage. Six pounds of arsenate of lead (15 per cent arsenic oxide) was used to each 50 gallons of water and approximately the same formula as given above for the bordeaux mixture. 375 gallons of spray were applied to the 85 trees, it being sufficient to cause dripping in almost every instance. There was at this time no evidence of codling moth work, aside from possibly one apple which may have been entered at the side. Larvae of the green-striped apple worm, Xylina antennata Walk. and also those of a Tortricid, were rather abundant. The latter hid between the leaves and ate them as well as contiguous fruit. Apples were picked up under the experimental trees and classified August 24th, September 13th and October 4th–5th.

An examination of this orchard June 30th showed that the conditions were not so satisfactory as at Arlington. There was considerable bordeaux injury, especially on the plots receiving the early application. The poison was very evident on all the experimental trees. Those of plot 3, sprayed only on June 1st, showed less bordeaux injury than the others. The fruitage on some of the trees was disappointing, since many of the blossoms failed to set. Work of the Tortricid leaf roller, mentioned above, and the green fruit worm was quite evident.

An examination October 4th and 5th revealed much injury from the bordeaux mixture, many of the apples checking and codling moth larvae of the second brood entering at such points. An effort was made to approximate this injury and small, random samples from various trees were carefully sorted. The results are tabulated as follows:

Tree 1A	26 smooth,	48 injured
1B	12 "	31 "
1C	30 "	25 "
2C	3 "	30 "
2D	4 "	32 "
2F	19 "	19 "
3A	12 "	18 "
3B	12 "	25 "
3D	10 "	29 "
X	77 "	23 "

We endeavored, in the above table, to put in the smooth class only those apples which were at least fairly smooth. A large proportion of those classed as injured were not seriously affected, aside from appearance, though some were badly gnarled and even cracked. It will be seen at once that a very high percentage of the fruit on all the sprayed trees were more or less rusted, while the proportions are approximately reversed on the unsprayed trees. Burning by bordeaux mixture was strikingly illustrated in Mr Shons' Ben Davis, some 90 to 95 and possibly 99 per cent of the apples being badly rusted and in some cases so seriously affected (pl. 13) that portions of the apple were irregular and more or less covered with rounded, tuberclelike elevations.

A considerable number of apples had been entered at the stem. The Tortricid larva, mentioned above, was still working on the apples in some numbers, either under a leaf, on the side of the fruit or beneath a light web at the blossom end. A note made by Mr Young September 13th records that over 90 of the 115 clean apples dropped from tree E, plot 3, had been gnawed by some larvae, probably that of this Tortricid. The work of this insect is illustrated on plates 10 and 11. A tabulation of the data obtained upon these plots follows.

Series 2, plot 1

TREE	DATE	TOTAL FRUIT	CLEAN FRUIT		WORMY FRUIT						
			Total	%	Total	%	End wormy	End and side wormy	Side wormy	Exit hole 1	Exit hole 2
A	Aug. 24.......	65	36	....	29	....	1	1	27	23	1
	Sept. 13.......	42	18	....	24	....	......	1	23	14	.....
	Oct. 4-5.......	310	180	....	130	....	11	1	118	40	.....
	Oct. 18-19.....	249	168	....	81	....	12	2	67	17	.....
		1262	1226	....	36	....	4	......	32	.....	.....
		1928	1628	84.44	300	15.56	28	5	267	94	1
B	Aug. 24	43	28	....	15	....	......	1	14	11	.....
	Sept. 13.......	52	33	....	19	....	1	......	18	12	1
	Oct. 4-5.......	391	182	....	209	....	27	5	177	81	.....
	Oct. 18-19.....	259	168	....	91	....	18	......	73	7	.....
		911	880	....	31	....	8	1	22	.....	.....
		1656	1291	77.96	365	22.04	54	7	304	111	1
C	Aug. 24.......	77	43	....	34	....	1	......	33	25	.....
	Sept. 13.......	83	58	....	25	....	3	......	22	20	1
	Oct. 4-5.......	257	156	....	101	....	9	......	92	38	.....
	Oct. 18-19.....	102	77	....	25	....	4	......	21	2	.....
		578	568	....	10	....	1	......	9	.....	.....
		1097	902	82.22	195	17.78	18	......	177	85	1
D	Aug. 24.......	60	38	....	22	....	1	......	21	16	.....
	Sept. 13.......	48	33	....	15	....	......	......	15	13	.....
	Oct. 4-5.......	185	85	....	100	....	9	5	86	30	.....
	Oct. 18-19.....	183	118	....	65	....	11	2	52	19	.....
		602	585	....	17	....	1	......	16	2	.....
		1078	859	79.68	219	20.32	22	7	190	80	.....
E	Aug. 24.......	59	44	....	15	....	1	4	10	10	.....
	Sept. 13.......	35	26	....	9	....	2	......	7	6	.....
	Oct. 4-5.......	279	158	....	121	....	5	......	116	40	.....
	Oct. 18-19.....	217	161	....	56	....	8	1	47	.....	.....
		902	887	....	15	....	3	......	12	1	.....
		1492	1276	85.52	216	14.48	19	5	192	57	.....
F	Aug. 24.......	33	16	....	17	....	......	......	17	13	.....
	Sept. 13.......	37	25	....	12	....	......	......	12	7	.....
	Oct. 4-5.......	152	84	....	68	....	8	2	58	36	.....
	Oct. 18-19.....	133	81	....	52	....	9	1	42	2	.....
		529	515	....	14	....	2	......	12	.....	.....
		884	721	80.43	163	19.57	19	3	141	58	.....
	Grand total..	8135	6677	82.08	1458	17.92	160	27	1271	485	3

Series 2, plot 2

TREE	DATE	TOTAL FRUIT	CLEAN FRUIT		WORMY FRUIT						
			Total	%	Total	%	End wormy	End and side wormy	Side wormy	Exit hole 1	Exit hole 2
A	Aug. 24.......	70	51	....	19	....	1	1	17	17	.....
	Sept. 13.......	49	39	....	10	....	......	......	10	6	.....
	Oct. 4–5.......	273	132	....	141	....	4	......	137	41	.....
	Oct. 18–19.....	126	86	....	40	....	11	......	29	9	.....
		583	572	....	11	....	3	......	8	.....	.....
		1101	880	79.93	221	20.07	19	1	201	73	.....
B	Sept. 13.......	227	127	....	100	....	12	......	88	65	.....
	Oct. 4–5.......	442	335	....	107	....	33	......	74	31	.....
	Oct. 18–19.....	284	217	....	67	....	13	......	54	7	.....
		1305	1284	....	21	....	4	......	17	2	.....
		2258	1963	86.94	295	13.06	62	......	233	105	.....
C	Aug. 24.......	38	25	....	13	....	2	1	10	9	.....
	Sept. 13.......	55	31	....	24	....	......	1	23	11	.....
	Oct. 4–5.......	226	131	....	95	....	1	......	94	25	1
	Oct. 18–19.....	127	85	....	42	....	1	1	40	6	.....
		685	675	....	10	....	......	......	10	.....	.....
		1131	947	83.73	184	16.27	4	3	177	51	1
D	Aug. 24.......	25	18	....	7	....	......	......	7	4	.....
	Sept. 13.......	69	49	....	20	....	2	1	17	14	1
	Oct. 4–5.......	192	105	....	87	....	3	......	84	22	2
	Oct. 18–19.....	182	122	....	60	....	7	1	52	14	.....
		480	473	....	7	....	1	......	6	1	.....
		948	767	80.90	181	19.10	13	2	166	55	3
E	Aug. 24.......	8	2	....	6	....	......	......	6	6	.....
	Sept. 13.......	7	5	....	2	....	1	......	1	1	.....
	Oct. 4–5.......	27	17	....	10	....	......	......	10	2	1
	Oct. 18–19.....	30	23	....	7	....	1	......	6	1	.....
		62	59	....	3	....	1	......	2	1	.....
		134	106	79.09	28	20.91	3	......	25	11	1
F	Aug. 24.......	96	64	....	32	....	2	......	30	24	.....
	Sept. 13.......	103	69	....	34	....	4	1	29	14	.....
	Oct. 4–5.......	376	214	....	162	....	13	2	147	30	.....
	Oct. 18–19.....	196	136	....	60	....	4	1	55	16	.....
		973	959	....	14	....	3	......	11	2	.....
		1744	1442	82.68	302	17.32	26	4	272	86	.....
	Grand total..	7316	6105	83.45	1211	16.55	127	10	1074	581	5

Series 2, plot 3

TREE	DATE	TOTAL FRUIT	CLEAN FRUIT		WORMY FRUIT						
			Total	%	Total	%	End wormy	End and side wormy	Side wormy	Exit hole 1	Exit hole 2
A	Aug. 24	183	60	....	123	....	46	7	70	64	5
	Sept. 13	170	77	....	93	....	51	7	35	31	.....
	Oct. 4-5	537	140	....	397	....	162	58	177	79	2
	Oct. 18-19	219	84	....	135	....	71	9	55	8	.....
		371	308	....	63	....	33	4	26	4	.....
		1480	669	45.20	811	54.80	363	85	363	186	7
B	Aug. 24	184	79	....	105	....	30	9	66	70	2
	Sept. 13	113	62	....	51	....	23	1	27	13	.....
	Oct. 4-5	429	124	....	305	....	140	35	130	69	9
	Oct. 18-19	213	104	....	109	....	65	5	39	15	.....
		565	546	....	19	....	12	......	7	.....	.....
		1504	915	60.84	589	39.16	270	50	269	167	11
C	Aug. 24	52	14	....	38	....	26	1	11	21	1
	Sept. 13	42	4	....	38	....	24	6	8	12	.....
	Oct. 4-5	115	24	....	91	....	50	14	27	19	.....
	Oct. 18-19	46	18	....	28	....	19	2	7	4	.....
		60	54	....	6	....	6	......	......	.....	.....
		315	114	36.19	201	63.81	125	23	53	56	1
D	Aug. 24	151	50	....	101	....	39	3	59	44	3
	Sept. 13	143	60	....	83	....	40	8	35	30	.....
	Oct. 4-5	456	156	....	300	....	111	29	160	86	4
	Oct. 18-19	185	84	....	101	....	56	3	42	15	.....
		773	746	....	27	....	17	......	10	2	.....
		1708	1096	64.17	612	35.83	263	43	306	177	7
E	Aug. 24	229	115	....	114	....	65	1	48	60	2
	Sept. 13	164	39	....	125	....	46	37	42	44	1
	Oct. 4-5	527	127	....	400	....	196	35	169	94	3
	Oct. 18-19	197	66	....	131	....	70	22	39	32	.....
		433	401	....	32	....	13	11	8	5	.....
		1550	748	48.26	802	51.74	390	106	306	235	6
F	Aug. 24	87	49	....	38	....	16	1	21	21	1
	Sept. 13	37	27	....	10	....	5	......	5	3	.....
	Oct. 4-5	138	86	....	52	....	8	5	39	16	.....
	Oct. 18-19	133	95	....	38	....	10	5	23	7	.....
		642	556	....	86	....	35	8	43	14	.....
		1037	813	78.39	224	21.61	74	19	131	61	1
	Grand total	7594	4355	57.35	3239	42.65	1485	326	1428	882	33

Series 2, check trees

TREE	DATE	TOTAL FRUIT	CLEAN FRUIT		WORMY FRUIT						
			Total	%	Total	%	End wormy	End and side wormy	Side wormy	Exit hole 1	Exit hole 2
X	Aug. 24.......	116	10	....	106	....	54	18	34	47	3
	Sept. 13.......	77	9	....	68	....	43	14	11	14	2
	Oct. 4–5.......	136	24	....	112	....	62	16	34	29	.....
	Oct. 18–19.....	50	22	....	28	....	14	6	8	2	1
		117	98	....	19	....	17	......	2	3	.....
		496	163	32.86	333	67.14	190	54	89	95	6
Y	Aug. 24.......	227	22	....	205	....	70	83	52	89	6
	Sept. 13.......	106	23	....	83	....	52	7	24	19	.....
	Oct. 4–5.......	529	68	....	461	....	228	97	136	96	5
	Oct. 18–19.....	290	65	....	225	....	102	71	52	53	3
		352	252	....	100	....	58	12	30	20	.....
		1504	430	28.59	1074	71.41	510	270	294	277	14
	Grand total.....	2000	593	29.65	1407	70.35	700	324	383	372	20

This series, it will be seen by reference to the above tables, presents markedly different conditions in certain respects from those of series 1. There was a considerably larger setting of fruit, the totals for the three plots being remarkably uniform, and in addition there was a very serious infestation by codling moth. This was probably due in part, at least, to local conditions and it is possible that the sprayings were not quite so thorough as those in series 1. The entire equipment was different and it is by no means easy to make exact comparisons. An earnest attempt was made to secure the most thorough work possible under the conditions. It is very likely that a portion of the discrepancy in percentages may be due to the difference in varieties in series 1 and 2. Data upon this point is given in the case of two other varieties in series 3.

A study of the data given under plot 1 shows that the minimum tree F produced 884 apples, 80.43 per cent being sound, while the maximum tree B yielded 1656 apples and but 77.96 per cent free from worms. The maximum percentage of sound fruit, namely 85.52 per cent, was produced by tree E with its total of 1492 apples, while the minimum percentage of sound fruit, 77.96 per cent, contrary to the usual rule, was found on tree B mentioned above. The number of wormy fruit under individual trees ranged from 195 or 17.78 per cent on tree C to 365 or 22.04 per cent on tree B. In the case of the latter, we would call attention to the fact that practically all the wormy apples were on the ground by October 18th. The maximum number of side wormy or end and side wormy apples, 311 or nearly 19 per cent of the total, were found on tree B, less than .5 per cent of these being also end wormy. The minimum number of side or end and side wormy apples was found on tree F. This was 144 or 16.3 per cent of the total yield, less than .4 per cent being also end wormy. The entire plot produced 8135 apples, of which 1298, or 15.9 per cent, were side wormy or end and side wormy, the latter being a practically negligible quantity.

Plot 2 had the minimum yield of 134 on tree E, 79.09 per cent being sound. The maximum number of apples, 2258, was produced by tree B, which yielded 86.94 per cent of sound fruit. This tree also produced the maximum number, 295, of wormy fruit, amounting however, to but 13.06 per cent of the total yield. The smallest number of wormy apples, 28, was found on tree E, and constituted 20.91 per cent of the entire product. Percentage comparisons are very strongly in favor of B, though as an actual fact it bore ten times as many wormy apples. The maximum number of side wormy or end and side wormy apples, 276, occurred on tree F, and comprised 15.8 per cent of the entire product, less than 2 per cent of the whole yield being end wormy. The minimum number of side wormy apples, 25, were found on tree E and amounted to 18.6 per cent of the total yield, less than 2 per cent being end wormy. Here again we see the injustice of strictly percentage comparisons, since F had ten times as many wormy apples as E, yet the percentage of sound fruit is strongly against the latter. This plot as a whole produced 7316 apples, 1084 or 14.8 per cent being side wormy or end and side wormy. A comparison between plots 1 and 2 shows a gain in sound fruit from the second spraying of only 1.37 per cent, though there were 247 less wormy apples on plot 2 than on plot 1.

Plot 3 presents an entirely different set of conditions, since it was sprayed but once and then in early June. The minimum tree C yielded but 315 apples, only 36.19 per cent being sound. The maximum tree D produced 1708 apples, 64.17 per cent being free from worms. The wormy apples range in number from 811 in tree A to 201 in tree C, comprising 54.80 per cent and 63.81 per cent, respectively, of the entire product. The maximum number of end wormy or end and side wormy apples was found on tree A with its 448 thus classed, forming 30.2 per cent of the entire yield. The minimum number of 76 was produced by tree C and comprised 24.1 per cent of the total. The entire plot yielded 7594 apples, 1754 or 23 per cent of the total being side wormy. The plot as a whole yielded but 57.35 per cent of sound fruit, showing a marked discrepancy between it and the two preceding plots.

The two check trees produced 2000 apples, which is not far from a fair average as these trees ran, 1407 or 70.3 per cent of the total were wormy, 707 or 35.35 per cent being side or end and side wormy and 1044 or 51.2 per cent being end or end and side wormy.

Series 3. The young orchard of Mr William Hotaling of Kinderhook, was selected for certain corroborative experiments. The trees are exceptionally fine, only about five or six years old, dwarf in habit and, as a rule, heavily laden for such young trees. They are set in four rows running approximately north, with rows of peach trees between, and, in the case of the experimental areas, the Wealthy apples are alternated with Mackintosh. The actual experimental trees were on the 30th to 35th transverse rows north from the house and located on the two middle longitudinal rows. The check trees were similarly located on the 25th and 26th transverse rows. The data relating to the two varieties has been tabulated separately. The western row of the experimental trees was sprayed with arsenate of lead (15 per cent arsenic oxide) 3 pounds being used to a 44 gallon barrel, and a lime-sulfur solution, the latter composed of 1 gallon of a homemade concentrated wash testing about 35° on a Baumé scale to about 40 gallons. The eastern row of experimental trees received the same application, except that the bordeaux mixture, composed of 4 pounds of lime and 3 pounds of blue vitriol, was substituted for the lime-sulfur wash. The spraying was done May 17th, a hand pump with a rather fine Friend nozzle being employed. Care was exercised to see that the mixture was well stirred. The application was made by Mr Hotaling personally. He took special pains to cover the under, as well as the upper, surface of the leaves, being in this respect possibly a little more thorough than in his efforts to fill the upturned calyx ends of the young fruit. Almost every leaf was well coated and only a very little dripping was observed. It is possible, owing to the slight breeze, that the northeast side of the trees was not sprayed quite so thoroughly as other portions. The intervening peach trees were not sprayed. This orchard had been well sprayed the preceding two seasons.

The fruit was picked September 16th. It is probable that a large percentage, possibly 50 per cent, of the wormy fruit was attacked at points injured by a hailstorm which occurred May 30th. These places afforded almost ideal opportunities for the entrance of young codling moth larvae. The results are tabulated on page 30.

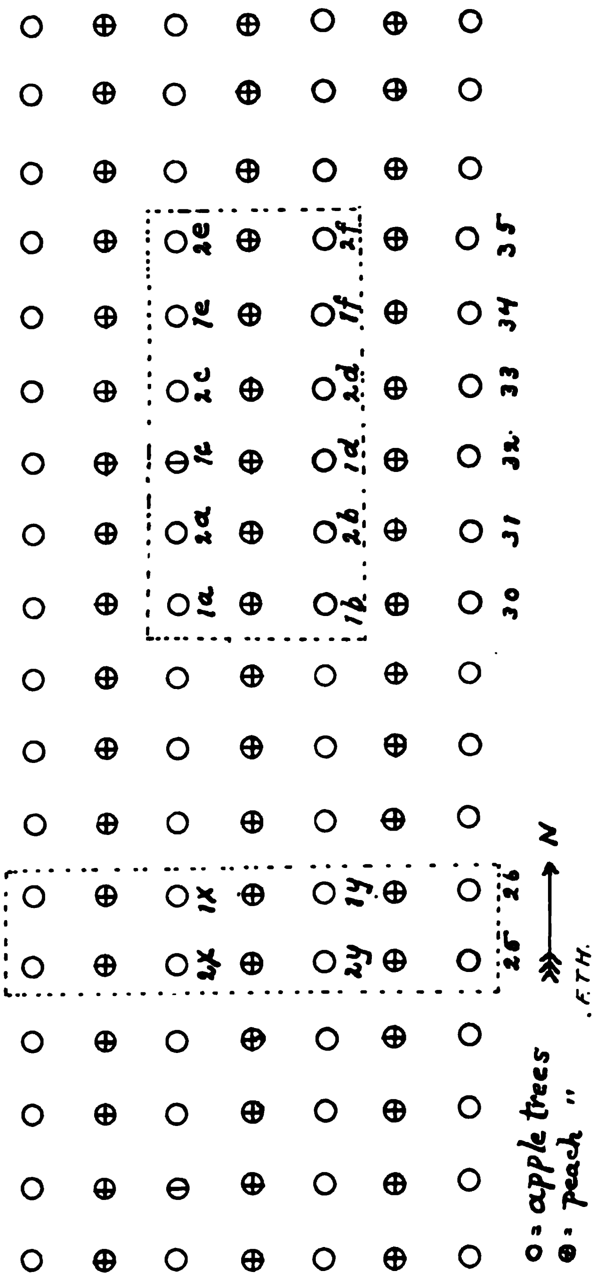

Fig. 3 Portion of orchard at Kinderhook, showing the location of the experimental trees

Series 3, Wealthy

TREES	TOTAL FRUIT	CLEAN FRUIT		WORMY FRUIT						
		Total	%	Total	%	End wormy	End and side wormy	Side wormy	Exit hole 1	Exit hole 2
1A................	106	84	79.25	22	20.75	3	......	19	3	.....
1B................	28	23	82.14	5	17.86	2	......	3	.....	.....
1C................	160	114	65.22	46	34.78	2	......	44	7	.....
1D................	81	51	62.97	30	37.03	1	......	29	5	.....
1E................	121	73	60.33	48	39.67	4	......	44	8	.....
1F................	33	26	78.79	7	21.21	......	......	7	.....	.....
Grand total........	529	371	70.14	158	29.86	12	......	146	23	.....
				CHECK TREES						
1X................	38	18	47.37	20	52.63	8	6	6	.....	.....
1Y................	50	18	36.	32	64.	12	7	13	2	.....
Total..............	88	36	43.19	52	56.81	20	13	19	2	.....

Series 3, Mackintosh

TREES	TOTAL FRUIT	CLEAN FRUIT		WORMY FRUIT						
		Total	%	Total	%	End wormy	End and side wormy	Side wormy	Exit hole 1	Exit hole4 2
2A................	179	110	61.46	69	38.55	8	2	59	16	.....
2B................	16	8	50.	8	50.	1	......	7	3	.....
2C................	105	51	48.57	54	51.43	6	......	48	6	.....
2D................	87	27	31.04	60	68.96	9	2	49	10	.....
2E................	......	......	......	......	......	......	......	......	......	.....
2F................	57	23	40.36	34	59.64	1	......	33	9	.....
Grand total........	444	219	49.33	225	50.67	25	4	196	44	.....
				CHECK TREES						
2X................	15	5	33.34	10	66.66	6	1	3	2	1
2Y................	375	125	33.34	250	66.66	78	37	135	51	3
Total..............	390	130	33.34	260	66.66	84	38	138	53	

This series illustrates conditions where a minimum crop is produced. The maximum Wealthy tree C yielded but 160 apples, 65.22 per cent being sound, while the minimum B bore but 28, 82.14 per cent being free from worms. The maximum percentage, 79.25, of sound fruit was produced by tree A, yielding only 106 apples, while the minimum percentage, 60.33, occurred on tree E with its crop of 121 apples and its maximum number, 48, of wormy apples. The minimum number of wormy apples was 5, occurring on tree B and constituting 17.86 per cent of the total product, 11 per cent being side wormy. This plot produced only 529 apples, 70.14 per cent being sound, 27 per cent of the total side wormy, while only 2 per cent were end wormy.

The two check trees yielded 88 apples, only 43.19 per cent being sound and with the side and end wormy nearly equal in number.

The Mackintosh trees in this series show a greater degree of infestation, though they were interspersed with the others. The maximum tree A produced 179 apples, 61.46 per cent being sound, and also the maximum number of wormy fruit, namely 69. The minimum tree B yielded only 16 apples, 50 per cent being sound, while the minimum per cent of sound fruit, 31.04, was found on tree D with its total of 87 apples. The minimum number of wormy apples occurred on tree B, 8, or one-half the total number being thus affected. Summarizing the data for this group of trees, it will be seen that only 49.33 per cent of the total yield of 444 were sound. A total of 45 per cent of the fruit was side wormy, while only about 6 per cent was end wormy.

The check trees produced a total of 390 apples, only 33.34 per cent being sound. 45 per cent were side wormy or end and side wormy, while 31 per cent were end wormy or end and side wormy, showing in this respect a marked difference from the fruit borne by the sprayed trees.

Summary of plots

SERIE	PLOT	TOTAL	CLEAN FRUIT		WORMY FRUIT						
			Total	%	Total	%	End wormy	End and side wormy	Side wormy	Exit hole 1	Exit hole 2
1	1............	1839	1664	90.48	175	9.52	16	21	138	83	3
	2............	2846	2756	96.84	90	3.16	6	1	83	33	.....
2	1............	8135	6677	82.08	1458	17.92	160	27	1271	485	3
	2............	7316	6105	83.45	1211	16.55	127	10	1074	581	5
	3............	7594	4355	57.35	3239	42.65	1485	326	1428	882	33
3	Wealthy......	529	371	70.14	158	29.86	12	......	146	23	.....
	Mackintosh...	444	219	49.33	225	50.67	25	4	196	44	.....
1	Checks.......	711	202	28.41	509	71.59	186	240	82	298	40
2	Checks.......	2000	593	29.65	1407	70.35	700	324	383	372	20
3	Wealthy checks	88	36	43.19	50	56.81	20	13	19	2	.....
4	M'k't'h checks	390	130	33.34	260	66.66	84	38	138	53	4

A study of the above record shows almost the same percentage of infestation, namely 71.59 and 70.35 respectively, for the check trees in series 1 and 2. These two orchards were in the same general region and the results should therefore be approximately comparable. There is, however, a markedly higher percentage of side or end and side wormy in the checks of series 1, this totaling 322 and amounting to 45.28 per cent, while in series 2 the checks produced 707 side or end and side wormy, or but 35.35 per cent. The number of side wormy alone in these two checks is approximately proportional to the number of apples produced by the respective trees. These figures would indicate, in a general way at least, substantially identical conditions in the two series so far as infestation by the codling moth is concerned. A comparison of the percentage of wormy apples obtained on plots 1 and 2 in series 1 and those obtained on plots 1 and 2 in series 2, shows a marked and constant variation. Plot 1 series 1 produced 90.48 per cent of sound fruit, while the similar plot in series 2 yielded only 82.08 per cent. Likewise, plot 2 in series 1 bore 96.84 per cent of sound fruit, number 2 of series 2 yielding only 83.45 per cent of worm-free fruit. It will be seen that there was a variation of from a little over 8 to over 13 per cent in favor of the plots in series 1. This may be explainable in part by the fact that the orchard in series 1 was younger and somewhat cleaner than in series 2, though it would seem as if some of this discrepancy must be attributed to less efficient spraying in series 2, especially as the experience of last year showed that an apparently minor factor, namely, a slightly less thorough spraying on one portion of a tree, resulted in reducing the amount of sound fruit by 2 to 3 per cent, and it is possible that a slight difference in the thoroughness of application, accentuated perhaps by the lack of an automatic mechanical agitator, was responsible for most of this discrepancy. There may also have been in the case of series 2 less thorough work on the trees adjacent to the experimental area than was the case in series 1. This was especially likely to occur on the trees lying on a steep hillside to the southeast of the experimental trees, where spraying could hardly be so thorough as in the comparatively level orchard where the experiments in series 1 were conducted. Allowance should also be made for the difference in varieties. Furthermore, the trees in this orchard were rather close together and this would be a great hindrance to the best work. It is interesting to compare the side or end and side wormy between these various plots. Plot 1, series 1, produced only 159, constituting some 8.64 per cent for the entire yield, while plot 1, series 2, yielded 1298 such fruit or 15.9 per cent of its entire product. Similarly, plot 2 of series 1 bore 84 side or end and side wormy, only 3.3 per cent of the entire yield, while plot 2, series 2, produced the relatively much larger number of 1084 or 14.8 per cent of the total number. Stated in another way, if we take the check trees as a standard, one application in plot 1 reduced the percentage of side or end and side wormy by 36.64 per cent, while a similar application to plot 1 in series 2 reduced this percentage only 19.45 per cent. Likewise, two applications in series 1 made a difference of 41.98 per cent of side or end and side wormy, while in plot 2 there was a difference in this respect of only 20.55 per cent. These figures all go to show that for some reason there was a decidedly lower efficiency in series 2 than in series 1.

Plot 3 of series 2 illustrates a totally different condition, since the one spraying was not given till about June 1st. We find a much lower percentage of sound fruit, namely 57.35, while the tree yielded

1754 side or end and side wormy apples, or 23 per cent of its entire product, or this one application, taking the check trees again as a standard, reduced the percentage of side or end and side wormy by only about 12 per cent. These figures give an excellent idea of the relative inefficiency of one application made at this season of the year.

A comparison of the totals in series 3 reveals an entirely different condition of affairs. The percentage of sound fruit was only 70.14 on the Wealthy and but 49.33 on the Mackintosh, the former variety yielding 146 side or end and side wormy, or 27 per cent of the entire product, while the latter produced 200 such apples or 45 per cent of the total yield. The checks in the Wealthy and Mackintosh respectively had 43.19 and 33.34 per cent of sound fruit, the former variety producing 32 side or end and side wormy, or 36.36 per cent, while the latter variety yielded 176 such apples, or 45 per cent. Again, taking the checks as a standard, it will be seen that, in the case of the Wealthy, one spraying reduced the wormy apples by 26.95 per cent, while on the Mackintosh the same treatment gave a reduction of only 15.99 per cent. The spraying of the Wealthy trees reduced the percentage of side and end and side wormy by about 9 per cent, while there was apparently no benefit in this respect on the Mackintosh. Percentage comparisons are certainly not very favorable when applied to small trees producing only 16 to a maximum of 375 apples, though they yield from only 5 to 69 wormy apples, a number smaller than that found on any trees in the other series where the percentages of sound fruit are much greater.

Tabulation of side wormy apples

SERIES	PLOT	NUMBER	%
1	1	159	8.64
	2	84	3.3
2	1	1 298	15.9
	2	1 084	14.8
	3	1 754	23.
3	Wealthy	146	27.
	Mackintosh	200	45.
	1 Check	322	45.28
	2 "	707	35.35
	3 "	....	....
	Wealthy check	32	36.36
	Mackintosh check	176	45.

Comparison of data with work of previous year. A comparison of the summarized figures given above with those obtained in 1909 shows that the codling moth was very much more abundant and injurious last season. This is true of the check trees as well as of those which were sprayed. The check trees of last year produced as much sound fruit as some of the sprayed trees in 1910, though this is true only where very exceptional conditions prevailed. The percentage of wormy fruit was very much less than the present year, while the percentage of side and end and side wormy was even smaller, ranging in plots 1 to 6 in 1909 from less than 1 to 1.3 per cent. A similar condition obtained on the check trees, which produced 17.62 per cent of side or end and side wormy.

Conclusions. The data secured shows that it is possible with but one spraying to obtain over 90 per cent of sound fruit in a year when the codling moth is very abundant, even on trees yielding only 300 to 500 apples. A larger crop, as pointed out on preceding pages and in our discussion of the effects of maximum and minimum crops on the percentage of wormy fruit in 1909, would undoubtedly result in the production of a still greater proportion of sound fruit.

Second, we believe that the possibilities of one thorough timely spraying have habitually been underrated. The second application within a week or ten days after the blossoms drop, is practically a confession that the first spraying was not thorough. It is true that ideal conditions are rarely present and it not infrequently happens that spraying must be done even when working at a disadvantage. There are, therefore, times when a second spraying justifies itself, particularly if this is made about three weeks after the blossoms fall and at a time when the young apple worms are beginning to feed upon the foliage and search for a favorable point of entry upon the fruit.

Third, a later application would pay for itself under such conditions as obtained the past season, though the percentage of sound fruit might not be greatly augmented. Here we have an excellent opportunity for exercise of judgment. A large crop with indications showing only a moderate abundance of the codling moth should mean that in the great majority of cases one spraying would afford adequate protection. On the other hand, a small crop, especially if likely to be accompanied by high prices, would at least justify a second application.

Fourth, adverse conditions, such as crowded trees, steep slopes, inferior spraying outfits, etc., make thorough work difficult, and have an appreciable influence in increasing the percentage of wormy fruit, since thoroughness as well as timeliness is an important factor in controlling the pest.

Fifth, an adhesive poison, such as arsenate of lead, appears to be much more satisfactory, since it is not only fully as effective in checking the codling moth but appears to be extremely valuable in controlling such leaf feeders as the Tortricid observed upon the orchards in series 2. This insect and associated feeders are undoubtedly of importance in increasing the amount of wormy fruit.

Sixth, there are those who hold the single spray method to be of comparatively slight importance, even if nearly as efficient, because in many localities it is necessary, or has been considered necessary, to spray several times for the control of fungous diseases. Conditions in the Hudson valley are such as to hardly justify the repeated applications so generally in vogue in the western part of the State. Here, at least, we believe that a knowledge of the possibilities of one treatment will prove an important factor in encouraging thorough spraying and result in the more general production of sound fruit.

JUNIPER WEBWORM

Dichomeris marginellus Fabr.

Twigs of Irish juniper infested by a reddish brown, white-striped larva about one-quarter of an inch long were received February 28, 1910, from Mr S. G. Harris, Tarrytown. These active larvae webbed the needles together and it was found later that they throve almost as well upon the partially dried foliage as though it were in a succulent condition. A larger amount of material was kindly sent by Mr Harris in March and the species was also received through the State Department of Agriculture from Mr L. D. Rhind, Plandome, L. I. A fine series of moths was reared in late May and early June. These were provisionally identified as the above named species, the determination being confirmed by Mr August Busck of the United States National Museum.

This European species does not appear to have been previously discovered in America. Its distribution, as given by Dr H. Rebel, is Europe, except the polar regions and Siberia. A number of English localities are indicated by Meyrick in his British Lepidoptera. This beautiful imported species, easily recognized by its yellowish brown, broadly white-margined fore wings, will hardly become a serious pest, since its food plant is of very little commercial importance.

Life history. The active larvae are gregarious, spin a rather copious web and apparently thrive upon the dead or dying foliage almost as well, if not better, than upon the more healthy tissues. The transformation to the pupa occurs within the webbed mass, the beautiful moths appearing as stated above, the latter part of May or early in June. It is possible that there is more than one generation annually.

Description. *Adult.* Length 7mm., wing spread 15mm. Tongue brownish yellow, slender, length 4mm. Palpi porrect, compressed, about 2.5 mm. long, thickly scaled, the outer and apical portions dark brown, the dorsal part creamy white; near the middle there is a slender, light brown pencil, fuscous apically, nearly as long as the palp and extending dorsally. Antennae long, slender, finely serrate, sparsely scaled. Eyes black. The vertex crowned with a spreading mass of long, creamy white scales. Thorax creamy yellow, margined laterally and anteriorly with fulvous brown scales. Fore wings long, narrow, fulvous brown, anteriorly and posteriorly broadly white-margined, these markings disappearing just before the apex of the wing; the fringe on the apical portion of the fore wing a mottled grayish and dark brown; hind wings satiny white, the fringe long, delicate, the under surface of both wings a nearly uniform pearl-gray. Abdomen yellowish brown, the fifth, sixth and seventh segments slightly darker and apically with a tuft of long, brownish yellow scales. Legs mostly reddish bronze.

Pupa. Length 5.5 mm., rather slender, reddish brown, the wing and antennal cases dark brown and extending to the fourth and fifth abdominal segments, respectively, the latter reddish brown, margined posteriorly with light reddish brown, sparsely setose; terminal segment subacute, narrowly rounded, with a cluster of five or six irregular, long, slender, hooked spines.

Larva. Length 6 mm. Head dark reddish brown with sparse setae. Antennae yellowish brown, short; thoracic shield broad, a variable dark brown, setose. Body light brown, the segments distinct and longitudinally striped as follows: median stripe reddish brown, submedian stripes whitish, sublateral dark brown, the lateral stripes light reddish brown, all somewhat broken. Setae with a length about half the diameter of the body, light brown; tubercles small, brown; thoracic legs dark brown, prolegs yellowish white, apically light brown; anal plate reddish brown, the middle paler, posterior margin dark brown, sparsely setose.

Bibliography. The following are a few of the more accessible publications relating to this species. For additional citations the reader is referred to Rebel (1901).

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LARGE APHID SPRUCE GALL

Chermes cooleyi Gill.

Several specimens of this large gall on Colorado blue spruce were received July 22, 1910 through agents of the State Department of

Agriculture. At this time the galls were just opening and hosts of plant lice were issuing from their orifices. The aphids present a general resemblance to those of the more common spruce gall aphid, Chermes abietis Linn., though the galls themselves are easily distinguished by their greater size and especially their elongate character.

This new gall insect is a native of the Rocky mountain region and the Northwest, having been described in 1907 by Prof. C. P. Gillette, who states that he has observed this gall mostly upon blue spruce in Colorado from 4000 to 8000 feet altitude and chiefly upon Englemann's spruce above the 8000 foot line. He adds that he has seen specimens from the Northwest through the courtesy of both Drs Fletcher and Hopkins, and in each instance they were the typical galls of this new form. He finds this gall most numerous in parks or lawns where the blue spruce and the red fir are clustered together.

Description. The galls (pl. 17, fig. 1) are long, slender, terminal enlargements having a length of two inches or more and a diameter of approximately half an inch. According to Professor Gillette, they are always terminal and kill the end of the twig, except when the lice attack the bases of only a few needles on one side of the new growth, such being uncommon. Professor Gillette states that average galls have from 75 to 150 chambers, the lice from five large sized galls ranging in number from 463 to 996.

Aphids. The plant lice within the galls are light red in color with the bodies more or less covered with a white, waxy secretion which occurs both as a powder and as threads. (Gillette)

Stem mother. In winter or early spring grayish, about .6 mm. long by .3 mm. wide. Body almost black with a white secretion radiating as short, stout threads about the margins of the body and rising in a crest down the median line of the back. (Abstract from Gillette)

Adult viviparous female. Length 1 to 1.5 mm., width .8 to 1.2 mm., dark rusty brown, the dorsal surface mottled with dark spots, the wax glands which occur upon all segments but the last. Glands arranged as follows: A nearly continuous line on the anterior margin of the head and two patches on a side near the posterior margin, the thorax and abdominal segments with three glands on a side, but segments five to eight of the abdomen have the patches more or less united, especially in the dorsal rows, the other glands on the dorsum with pores quite uniform in size and rather small. Ventrally there is a pair of small patches upon the head behind the bases of the antennae and another pair of about the same size just in front of the middle coxae. Antennae very small, about as long as the femora of the fore legs; first and second segments short and stout, about equal; third nearly cylindric, nearly twice as long as segments one and two combined and with two tactile hairs apically.

Legs short, rather weak, tarsi biarticulate, the basal segment very short. (Abstract from Gillette)

Eggs. Length [illegible] mm., width [illegible] mm. They are light amber yellow at first, covered with a white powder. They are each attached by a thread, the whole mass adherent, an average sized one with a diameter of 2 mm. (Abstract from Gillette)

Winged female. Bright salmon, rufous at first but by the time the wings are expanded the eyes are black and a few hours later the head and mesothorax are black. The other portions gradually darken, the abdomen retaining the rusty color longest. The white secretion begins to show about an hour after the pupal skin is cast and the aphid soon flies away. Length 1.5 to 2 mm. Wings a little smoky with a large stigma that is slightly green and a yellow costal nerve. The median fore wing is about 2.5 mm. long or about 1.6 times the length of the body with two simple discoidal veins and one stigmatal; hind wing with one discoidal vein, length of the hind wing about equaling the length of the body. Antennae dusky, with five segments, about ½ as long as the greatest transverse diameter of the head; segments one and two short, stout, cylindric, about equal in length, segment one smooth, the others with impressed, transverse lines or wrinkles; segments three to five subequal, with segment three a little stouter and more conical; segments four and five rather slender, not especially enlarged apically nor swollen for the transverse sensoria, of which there is one to each of the three terminal segments, the fifth with two short hairs apically. (Abstract from Gillette)

Life history. The small, hibernating form of this aphid winters upon the twigs of its host plant with its long setae thrust into crevices in the bark between the needles. The heavy winter skin is cast about the middle of April and in a day or two the white, waxy secretion indicates the location of the louse, which is invariably on the under side of the twig. The first eggs are deposited in Colorado the latter part of April and before the female has attained her maximum size. The white, waxy threads completely hide both the egg and the female; a mass contains 500 eggs. The earlier deposited eggs begin to hatch before the females have completed laying, a large number of young being observed the latter part of the month. The formation of the gall is evidently produced by the young plant lice locating at the base of the young needles. The galls develop with surprising rapidity and are due to the thickening and lateral enlargement of the bases of the needles together with a swelling of the stem. They become fully developed about the first of July and by the middle or the latter part of that month most of the lice escape, a condition paralleled by our observations in New York. This generation in Colorado flies to the red fir, establishes itself upon the leaves and begins almost immediately to lay eggs which accumulate in large piles beneath the wings. Individuals of this generation may produce about 150 eggs. Occasionally a few specimens feed and oviposit upon the blue or silver spruce, though this is unusual. The aphids hatching from these eggs remain upon the red spruce throughout the winter and are probably the chief, though perhaps not the only, source of the variety coweni Gill. It is also considered probable that the stem mothers for the two summer broods of C. cooleyi Gill. come in a similar manner from the winged females of variety coweni Gill. of the red fir. (Abstract with additions from Gillette)

Remedial measures. It is probable that, as in the case of the spruce gall aphid, Chermes abietis Linn., thorough spraying of the infested trees in April with a whale oil soap solution, 1 pound to 2 gallons of water, would prove very effectual in checking this insect. The galls may also be cut off and burned in June, thus destroying the aphids before they have an opportunity to escape.

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ASH PSYLLA

Psyllopsis fraxinicola Först.

A number of small, yellowish or green, black-marked Psyllids, accompanied by badly curled ash leaves (pl. 15), were received from Rochester June 18, 1909. The insects were evidently very abundant and causing serious injury. The affected foliage was not only badly curled, but streaked here and there with purplish veins. The only other record of this European species in America appears to be that by Dr John B. Smith in his list of insects issued in 1899. He states that this Psyllid was imported from Europe and is quite injurious to ash trees. Dr L. O. Howard, through whose courtesy this species was determined, states that this form was found many years ago on the grounds of the Department of Agriculture, Washington, D. C. This species is reported as occurring all over Europe and, contrary to what we find in this country, the foliage is not deformed. It is about the same size as the widely distributed and much better known pear Psylla, Psylla pyricola Först, though easily distinguished therefrom by the white, tufted young, the lighter color and its occurrence upon ash.

Description. Length about 1/20 of an inch, yellowish or greenish and with yellowish or dark brown markings as follows: Submedian triangles on the pronotum; submedian and sublateral longitudinal stripes on the mesonotum and most of the metanotum. Antennae long, slender, yellowish or greenish, the first segment short, obconic, the second stout, cylindric, the third slender, fully three times the length of the second, the fourth less than ½ the length of the third and rather closely united with the somewhat longer fifth, the sixth, seventh, eighth and ninth, each subequal and about as long as the fifth, the tenth about ⅔ the length of the ninth, the eleventh reduced, ½ the length of the tenth and apically with stout spines, the ninth and tenth distally and the eleventh somewhat enlarged; eyes reddish. Fore wings mostly hyaline, variably fuscous along the anterior margin, near the distal third, in the region of the distal fourth and apically (pl. 16, fig. 1). The legs are a variable yellowish or green, the tarsi (pl. 16, fig. 6) being somewhat darker. The abdomen is yellowish or greenish with variable fuscous markings. The male of this species is remarkable because of the greatly developed genitalia projecting dorsally. The anterior organ is subtriangular and with a length about equal to half the width of the wing, while the posterior organ is irregularly subquadrate, stemmed and fuscous. A view of the extremity of the male abdomen is given on plate 16, figure 3. The female has somewhat the same general appearance as the opposite sex, being easily distinguished therefrom by the abdomen tapering to a subacute apex, bearing the ovipositor and secondary sexual organs (pl. 16, fig. 4).

The nymphs or young have the dorsum of the head mostly fuscous, the wing pads brown, the anterior abdominal segments greenish, the posterior fuscous and ornamented with a waxy secretion, the latter being produced at the lateral and posterior angles as long, waxy threads. The antennae are yellowish green, the basal and distal segments fuscous. The legs are yellowish green, the tarsi fuscous.

Life history. This species appears to have about the same life cycle as the pear Psylla, the adults wintering on the bark of the tree and the insects becoming abundant in June.

Control measures. It is probable that this pest could be controlled where circumstances warranted, by scraping the bark and spraying thoroughly in early spring with a contact insecticide, such as a lime-sulfur wash, a kerosene or petroleum emulsion, a strong whale oil soap solution or a tobacco extract for the purpose of destroying the hibernating Psyllids.

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NOTES FOR THE YEAR

The following are brief notices of some of the more injurious or interesting species which have been brought to our attention during the past year.

FRUIT INSECTS

Pear slug (Eriocampoides limacina Retz.). This insect very frequently occurs upon cherry and pear foliage in midsummer. The slug, only about one-half an inch long when full-grown is easily recognized by the slimy secretion covering an apparently olive colored or blackish, sluglike body, the anterior portion being distinctly enlarged. The work of this pest is very characteristic, since it skeletonizes the upper surface of the leaves more or less completely, the injured portion soon drying and turning brown. This species was unusually numerous the past summer in the vicinity of Kinderhook, N. Y., and extraordinarily abundant in the outskirts of Albion. The insect winters in the ground, the small, black, 4-winged, many veined sawflies, only about one-fifth of an inch long appearing in early spring and depositing their eggs singly in a slit through the upper surface of the leaf. The eggs hatch in about two weeks, the voracious slugs completing their growth in about twenty-five days. There are two generations, the larvae of the second usually being the more abundant and frequently occurring in numbers during July and early August.

It is comparatively easy to control this pest when necessary by spraying with a poison, since the somewhat sensitive slugs feed upon the upper surface and are therefore easily destroyed. One pound of arsenate of lead (15 per cent arsenic oxide) to 100 gallons of water would probably be sufficient, since paris green has been recommended at the rate of 1 pound to 250 gallons of water. The poison may also be applied dry or the slimy slugs destroyed by liberal, and if necessary, repeated applications of dry materials, such as air-slaked lime, land plaster, or even road dust.

Cigar case bearer (Coleophora fletcherella Fern.) Very few specimens of this destructive leaf miner were observed in apple orchards in the towns of Byron and Stafford, Genesee county, though it was quite abundant in some sections the preceding year and has been responsible, in part at least, for the practical destruction of several orchards. A serious infestation by this pest is likely to mean the loss of a crop, since the voracious caterpillars, after wintering in their characteristic cigar-shaped cases attached at right angles to the twigs and nearly a quarter of an inch long, are very hungry and devour the young leaves and developing blossom buds with equal avidity. Very thorough early applications of a poison, using preferably arsenate of lead (15 per cent arsenic oxide) is advisable wherever this pest is numerous, though we have yet to find an orchard which has been well sprayed for several years, badly infested by this pest.

Cherry fruit fly (Rhagoletis cingulata Loew). This relatively new pest of the cherry grower has been somewhat abundant and injurious to Morello cherries in particular, at Germantown and vicinity. Mr S. E. Miller states that in 1909 the cherry crops of some five or six growers in that section were rather seriously affected by this maggot, though an investigation of local conditions in 1910 leads us to believe that in some instances at least, the injury may have been due in part to the plum curculio, Conotrachelus nenuphar Herbst. An examination of conditions June 29, 1910 in the orchard of Mr Miller showed that a few adult flies could be found upon each tree. There were no signs of oviposition, though the insects were frequently observed upon the fruit. We found a number of cherries infested by the curculio, though there was no evidence of the presence of maggots. Mr Miller was not certain but that the major portion of the serious injury of last year was due to curculio attack rather than to the work of the fruit fly. This year he sprayed with a poisoned lime-sulfur wash earlier in the season and the application was doubtless of service in controlling the plum curculio. Mr Miller, at our suggestion, had sprayed the trees with sweetened arsenate of lead (3 pounds of sugar and 4 ounces of arsenate of lead to 5 gallons of water) the previous week, probably the 23d. The mixture was dry and very evident upon the margins of the leaves, though none of the flies were observed working thereupon. There was no evidence of dead insects.

The orchard was visited on the afternoon of July 5th by Assistant State Entomologist Young. The day was sunny and very hot and comparatively few flies were then seen. The next morning flies were more in evidence, especially in certain portions of the orchard. They were taken in copula and a number of individuals captured. The insects became more active as the day advanced though oviposition was not observed. Some of the poisoned bait prepared by Mr Miller and described above, was sprinkled on a branch at 9.55 a. m. at what seemed a favorable place for the flies, and, although there were numbers about the tree, it was five minutes before one alighted upon the sprinkled leaves. It appeared to feed and then walked about on the leaves and finally came to rest. It was observed for some thirty minutes moving about normally and then suddenly disappeared. A serious defect in the mixture is the rapidity with which it dries. It was found that individual flies could be captured by bringing the fingers near to the insect and then as it lit thereupon suddenly closing them. Subsequently it was found that the flies were attracted to the fingers probably because they were stained with cherry juice. This suggests that the poisoned bait mentioned above might be made more effective by the addition of some such flavor.

The evidence obtained the past season, while far from being as satisfactory as one would wish, is certainly not very promising so far as this poisoned bait is concerned. It is probable that our cherry growers will find a large measure of relief, if not practical immunity from injury, by picking cherries as soon as they are ripe and taking special pains to secure all the fruit, thus reducing the opportunities for the breeding of the flies and consequently lessening the danger of trouble the following season. We are inclined to believe that so far as this insect is concerned, prompt and thorough harvesting will afford a practical solution of the difficulty. Injury by plum curculio, an associate of the cherry fruit fly, can be controlled by persistent use of the beetle catcher or the employment of a poisoned mixture such as that used by Mr Miller the past season.

Lined red bug (Lygidea mendax Reut.).[1] Several years ago the late Professor Slingerland noticed briefly, as an apple insect, a small, red Hemipteron under the popular name of red bug (Heterocordylus malinus Reut). The form under discussion is very similar in appearance to the earlier described species, though easily separated therefrom by the much more prominent eyes and especially, as pointed out by our wellknown authority in this group, Mr E. P. Van Duzee, by the black line along the posterior margin of the pronotum.

The work of this new apple pest may be observed during May and early June on the three or four terminal, more tender leaves. These are more or less curled and frequently form partially inclosed retreats containing a brilliant red, partly grown bug. It is probable that this species injures the fruit as well as the red bug. The affected leaves have much the appearance of being injured by plant lice or aphids, though the ill-defined, brown spots suggest the possibility of their having been affected by sun scald or some obscure disease. The spotting of the tender leaves is somewhat the same as that on currant foliage, produced by the 4-lined leaf bug (Poecilocapsus lineatus Fabr.). Many tips were thus affected on the apple trees of Mr S. E. Miller of Germantown and the insect was somewhat abundant in the orchard of Mr C. R. Shons of Washingtonville, the nymph, presumably of this species, being taken in the last named orchard June 1st and three adults June 30th. The latter were secured only after repeated collecting, since the insects were by no means abundant. It is possible that some of the work described above is due to the operations of the red bug (Heterocordylus malinus Reut.) a species having similar habits.

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[1] 1909 Acta Soc. Scient. Fenn., v. 26, no. 2, p. 47.

These two forms resemble each other very closely and we take this opportunity to put on record their salient characteristics.

Lygidea mendax Reut. *Adult.* Length 6 mm., rather slender, the width 2 mm. The color varies from yellowish red to rather bright red and may be variably suffused with fuscous, this invariably forming a median stripe extending from the scutellum to the tip of the wing and including the membrane. Head dark red or yellowish red, the clypeus fuscous; rostrum extending to the posterior coxae, a variable fuscous yellowish, fuscous basally and apically. Eyes large, very protuberant, coarsely granulate. Antennae fuscous, hairy, first segment stout, with a length only half that of the greatly produced, slender second segment, the third segment slender, about half the length of the second, the fourth a little shorter than the third. Pronotum coarsely punctured, sparsely setose and margined posteriorly with a broad, black line, sometimes slightly broken mesially. Scutellum reddish or yellowish red, the posterior half, especially the submedian areas, a variable fuscous; the clavus, the internal angles of the wing, and the membrane mostly fuscous, forming a variable broad median stripe. Abdomen a variable red. Coxae red, trochanter and femora pale yellowish; tibiae fuscous yellowish or fuscous, the biarticulate tarsi a variable fuscous.

Partly grown nymph. Length 3 mm., width 2 mm., bright red, the tips of the wing pads a variable fuscous. Antennae yellowish fuscous. Legs mostly fuscous yellowish, the tibiae and tarsi slightly darker.

Heterocordylus malinus Reut. Length 6 mm., rather slender, width 2 mm., yellowish red or dark red with conspicuous fuscous markings and sparsely clothed with fine, whitish or yellowish white scales. Head triangular, mostly fuscous, the front sparsely clothed with small, whitish scales; rostrum a variable reddish brown and extending nearly to the posterior coxae. Antennae dark reddish brown, the first segment stout, length about 1/3 that of the greatly produced, more slender second segment, the slender third segment about ½ the length of the second, the fourth shorter than the third, the apical ⅔ slightly dilated. Eyes rather prominent, coarsely granulate and reddish brown. Pronotum reddish brown, the anterior third fuscous, except the lateral angles, all sparsely clothed with small, white scales. Scutellum, the most of clavus and the membrane fuscous; the corium mostly red with a variable fuscous area in the middle and sparsely clothed with fine scales. Abdomen reddish brown; coxae, femora and tibiae mostly reddish brown, the tarsi somewhat fuscous.

This species is easily distinguished from the preceding by the fuscous area anteriorly on the pronotum, the absence of a fuscous margin posteriorly and by the fine, whitish scales on the head, thorax and wings.

Professor Crosby of the Cornell Agricultural Experiment Station finds a tobacco whale oil soap solution applied just before blossoming to be an effective spray for use against the young red bugs.

Pear psylla (Psylla pyricola Först.). It will be recalled that the season of 1903 was remarkable for the excessive abundance of this jumping plant louse. It was so numerous then that pear trees with blackened, scanty foliage or almost none at all, were common sights during the summer, not only in the Hudson valley but also in central and western New York. Since then there has been comparatively little injury, at least of a general nature. Last season this pest was rather abundant in the pear orchard of James Clark at Milton. On July 21st there were numerous nymphs and some adults upon the trees and considerable honeydew, though this latter had disappeared largely following the rain of a few days earlier. There were very little or no Psylla to be seen upon the pear trees of Mr J. A. Hepworth near the river or upon those belonging to other growers in the immediate vicinity. Reports were received of serious injury by this pest in the central part of the State.

The experience of the past few years has shown that thorough spraying in early spring with a lime-sulfur wash, such as is used for the control of San José scale, is at least a powerful deterrent, if not a preventive of Psylla outbreaks. Mr J. R. Cornell of Newburgh believes that the efficacy of such treatment is materially increased by previously scraping the rough bark from the trees. This is undoubtedly true, and where orchards are liable to injury by this species we would advise careful scraping prior to the application of a lime-sulfur wash or a miscible oil. This should be followed in every instance by closely watching the trees during the summer. Should Psylla begin to be abundant it should be checked at once by thorough spraying with a kerosene or petroleum emulsion, a whale oil soap solution, or a tobacco preparation, making the application, if possible, just after a rain and using a coarse, forcible spray. The advantage of spraying just after a rain is that the moisture washes away in large measure the sticky excretion which protects the young Psyllas and thus renders them more susceptible to the application. A coarse spray is more effective than a fine, drifting fog because of its tendency to remove this protecting secretion.

San José scale (Aspidiotus perniciosus Comst.). The experience of the past year has but served to confirm the value of early and thorough applications of a lime-sulfur wash for the control of this pest. It is comparatively easy at the present time to find orchards which have been infested by San José scale for ten or fifteen years and yet show very few signs of its presence. This is due, in our opinion, to two factors. First, our methods of spraying have been gradually perfected so that the work of later years has been exceedingly thorough. Second, there has been a marked development in the preparation of the lime-sulfur washes, particularly in the commercial brands. There is no doubt as to the value of a well prepared homemade lime-sulfur wash, whether an excess of lime or a larger proportion of sulfur be employed. The formulas generally used till within the last year or two, usually called for a little more lime than sulfur. This preparation has demonstrated its effectiveness time and again and must still be regarded as an exceedingly valuable insecticide. Nevertheless, the so called concentrated lime-sulfur washes, distinguished from the earlier formulas by the use of approximately twice as much sulfur as lime by weight, have given exceedingly satisfactory results and possess several important advantages. This latter type of wash can be made up months in advance without danger of crystallization, provided freezing does not occur, and in a well made wash of this character there is practically no sediment. These two considerations are of great importance to the fruit grower who is frequently pushed for time in early spring, when the spraying can be done to best advantage, and is therefore unwilling or unable to take time to prepare the wash while spraying operations are being conducted. It is perhaps needless to add that this lack of sediment greatly reduces the danger of clogging nozzles and consequent delay in operations. Experiments have shown that the clear concentrated lime-sulfur wash is as effective, or at least nearly so, in destroying the scale as the old type of wash with its large excess of lime and frequently considerable sediment. The one trouble with the use of the clear mixture is the difficulty of doing thorough work, because when recently applied it can not be seen readily. This trouble can be obviated to a large extent by adding a little milk of lime to the diluted mixture, using it simply as a marker.

Certain reports have come to this office to the effect that the San José scale was becoming less abundant or even dying out in restricted localities here and there in the State. There are undoubtedly trees, and possibly orchards, where the scale has not thrived to any great extent in recent years, but we have yet to find substantial evidence showing this to be at all general. The scale appears to be most abundant upon vigorous trees, and while we would not state it as a general rule, we believe that in most instances freedom from infestation is correlated in large measure with reduced vitality and a consequently limited fruition.

Blister mite (Eriophyes pyri Nal.). This small pest, as shown by personal examination, is generally present in the orchards of Byron and Stafford, Genesee county, frequently being very abundant in those which have not been sprayed. This mite is widely distributed in the Hudson valley, though very rarely numerous enough to cause material injury. It was observed by the writer somewhat generally distributed in orchards at Clarksville, Albany county, and also very prevalent in the orchard of Mr Cecil Boudewyns at La Grangeville. There is no question as to the efficacy of early spring applications of a lime-sulfur wash or a miscible oil for the control of this pest. The general characteristics of its work and control methods have been discussed by the writer in Museum Bulletin 134, page 48.

GARDEN AND GRAIN INSECTS

Rose scale (Aulacaspis rosae Bouché). This insect is widely distributed in both Europe and America, occurring mostly upon rose, blackberry and raspberry bushes, particularly in sheltered locations. It is easily recognized by the thin, papery white, oval scale of the female only about one-sixteenth of an inch in diameter and with a small, yellowish patch, the protection of the immature stage, near its apex. The white male scale is easily recognized by its smaller size, the narrow three ridges and the small, yellowish particle at one extremity. The appearance of a blackberry cane rather badly infested by this insect is well shown in figure 4, while the female and male scale are represented much more enlarged in figure 5.

This rose pest is widely distributed in America, having been recorded from Florida and Louisiana northward to New York, and even from California. It is said to hibernate in an immature condition in the extreme south. Professor Comstock records the issuing of males, oviposition by females and hatching of eggs February 22d from material taken in Florida, while Professor Morgan states that young appear in Louisiana the last of March.

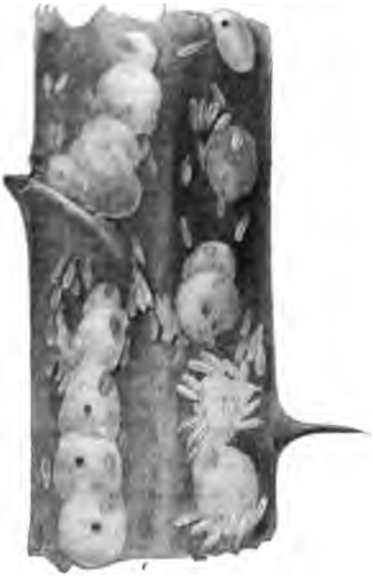

Fig. 4 Portion of blackberry cane enlarged and showing a rather bad infestation by the rose scale. Numerous female and male scales are represented.

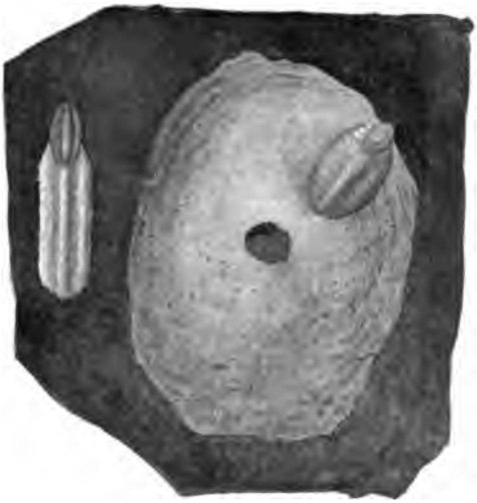

Fig. 5 Male and female rose scales much more enlarged

The middle of May 1901, infested twigs were received from Concordville, Pa., on which were gravid females, eggs and issuing males. Dr John B. Smith states that this species may winter in New Jersey in any stage from egg to gravid females, while we have at hand specimens from Ballston Spa taken in November 1910, showing both gravid females and eggs and indicating that this species probably winters in this condition. Office records show that this pest has been received from Cornwall-on-Hudson, Poughkeepsie, Hudson, Castleton, Ballston Spa, Cobleskill and Brighton near Rochester. Young were appearing in considerable numbers on the material received from Hudson in early June and the same was true of specimens from Cobleskill collected October 18th. This species begins to breed in New York State the latter part of May or in June and apparently produces young in greater or less numbers throughout the season, though Professor Smith believes that there are not more than three generations in New Jersey. Material collected in New York State showed the presence of several parasites, Arrhenophagus chionaspidis Aur., while Professor Toumy has reported the rearing of Aphelinus diaspidis How. from this species.

This pest, as was observed by Professor Smith, is very likely to be abundant in sheltered, shady situations, especially beside buildings. It can be controlled best by thorough spraying in the spring at the time the reddish young appear, with a whale oil soap solution, using about one pound to six or seven gallons of water and repeating the applications at intervals of a week or ten days, so long as the abundance of the pest appears to justify the treatment. A kerosene emulsion, the standard formula diluted with at least nine parts of water, should be equally effective.

Greenhouse leaf-tyer (Phlyctaenia rubigalis Guen.). The pale green, rather slender, black spotted caterpillars of this species were brought to our attention in October by John Dunbar, Assistant Superintendent of Parks, Rochester, N. Y. because of their feeding upon the underside of chrysanthemum leaves. He found that they also attacked geraniums and some other plants. Mr Dunbar attempted to control the species with applications of hellebore, nicotine and even by fumigation, using one ounce of cyanide of potassium to 5000 cubic feet of space without apparent results, though this last named treatment is an effective check upon the white fly.

This insect has been known in entomological literature by several names. It was first described by Guenee in 1854 as Scopula rubigalis, while other authors published descriptions of this form under the names of Botys oblunalis Led. and Botis harveyana Grote. This species has been assigned to other genera such as Margaritia, Pyrausta and Pionia. It has been frequently discussed under the name of Phlyctaenia ferrugalis Hübn., a nearly cosmopolitan, world-wide form distinct, according to Hampson, from the species we are considering. This latter appears to be widely distributed in North America, having been recorded in localities from the Atlantic to the Pacific coast and from Keywest north into Canada. It appears in its northern distribution at least, to be preeminently a greenhouse species.

The reddish brown and indistinctly black marked moth has a wing spread of about three-fourths of an inch. The fore wings are a variable yellowish brown with indistinct, serrate, blackish lines and spots. The hind wings are grayish and mostly indistinctly marked, both wings being margined by a row of rather distinct black spots. When at rest the hind margins of the posterior wings touch and the moth has a flattened, triangular shape.

The full-grown caterpillar is about three-fourths of an inch long, green or greenish yellow in color and somewhat transluscent. The head is light amber with obscure, pale brown, irregular markings, the first thoracic segment usually with a subdorsal pair of small, black spots, or the cervical shield may be transparent. The remainder of the body has a broad, greenish white dorsal stripe extending to the subdorsal region, with the darker alimentary tract showing through. This stripe in some individuals is whitish transparent and margined by narrow, white, subdorsal lines. The sides are pale yellowish green. The tubercles are small, piliferous, semitransparent and shiny. Anal segment with a subdorsal pair of small, irregular, black spots. The true legs are yellowish transparent, the prolegs semitransparent.

This caterpillar is a very general feeder, having been recorded by various writers as attacking celery, cabbage, beets, tobacco, Ageratum, geranium, ground ivy, German and Kenilworth ivy, violet, heliotrope, wall flower, wandering Jew, dahlia, daisy, Justicea, chrysanthemum, carnation, Cineraria, begonia, abutilon, roses, anemone, nasturtium, moon vine, Swainsonia, Genista, Plumbago, Matricaria, Passiflora, Ruellia, Tydaea, Lobelia, Veronica, Lantana, Deutzia, nodding thistle (Carduus), Ambrosia, several species, and Sisymbrium.

These somewhat general feeders are most noticeable in secluded situations and display a marked preference for the terminal leaves, eating holes in the latter. They feed chiefly at night, resting by day in one location, a retreat in which the final transformations usually occur. The duration of the larval existence extends from about three to possibly five weeks, and that of the pupa from one to presumably two weeks. It will thus be seen that several generations annually may be produced in greenhouses, considerable depending upon the conditions.

The experience of others as well as that of Mr Dunbar, cited above, shows this insect to be quite resistant to insecticides, such as hellebore, tobacco extracts, or fumigation with hydrocyanic acid gas. It is very probable that judicious and early under-spraying with a poison, particularly arsenate of lead, would prove an important means of controlling this pest. Such treatment is, as a rule, objectionable in greenhouses because of the accompanying disfiguration of the foliage.

Systematic hand picking, in connection with other work and including the destruction of the moths when at rest in a greenhouse, is perhaps as effective as any control method. This should be supplemented by isolating infested plants wherever noted and taking special pains to destroy all the insects thereupon before they are returned to the benches. Prevention of infestation is by all means the most satisfactory, and we would urge the exercise of great care to see that greenhouses are stocked in the fall with plants uninfested by this pest. There is always the possibility of moths of this species entering ventilators or doors in early fall. A careful watch should be kept for such infestations and should they occur great care exercised to destroy the caterpillars before the pest becomes abundant enough to cause serious trouble later in the season.

An extended account of this species, with references to other literature is given by F. H. Chittenden in Bulletin 27, new series, Division of Entomology, United States Department of Agriculture, from which certain of the above statements have been taken.

Wheat wireworm (Agriotes mancus Say). This common wireworm is best known because of its depredations upon wheat, its injuries being particularly severe in the Middle States. Mr Purley Minturn of Locke forwarded specimens and reported under date of May 20, 1910 that this pest had been quite injurious to oat fields in his vicinity, entirely ruining some. He adds that all badly infested fields had been in meadow for five years or more and were sown to buckwheat last year and to oats this spring. This species has also been recorded as injuring corn and potatoes.

The slender, tapering, brownish, slightly hairy parent insects, instantly recognized as click beetles or snapping beetles, occur in June. They are of a dark, waxy, yellow color and not readily differentiated from other numerous, very similar allies. The destructive form or larva of this species may be easily distinguished from other wireworms by the pointed posterior extremity and especially by the two dark brown or black pits on either side of the last segment and almost touching the preceding segment. These wireworms, when full grown, are from about one and one-fourth to one and one-half inches long, waxy, yellow, slender and hard. The parent insects presumably deposit their eggs near the roots of grasses and the young hatching therefrom require three years to complete the life cycle. The transformation to the delicate pupa occurs within an earthen cell in late summer or early fall, the beetles emerging the latter part of the following May or during June.

Owing to the hard, chitinous covering of the wireworms, they can not be readily destroyed by the application of insecticides of any kind. Their subterranean habits and preying upon field crops of comparatively small commercial value, also increase the difficulties of satisfactorily controlling the pests. Destructive wireworms are most likely to be abundant in sod, particularly that which has been seeded for some time, and it is therefore unwise to plant on badly infested sod crops liable to serious injury. Should the latter be necessary, something can be accomplished by plowing in early fall, since this process destroys the delicate pupae in their hibernating cells. Experiments have shown the practicability of killing the parent click or snapping beetles by the judicious use of poisoned baits, such as clover or lettuce dipped in strong paris green water. This can be done successfully only in midsummer, at the time the parent insects are abroad, and should be continued so long as numbers of beetles are attracted to the bait. Unfortunately, these measures are of no immediate service in a field badly infested by the pest. Prof. H. T. Fernald, as a result of certain experiments, provisionally recommends tarring corn and then placing the same in a bucket containing fine dust and paris green mixed in such proportions that the corn, after being shaken up in the bucket, shows a greenish color. Such corn feeds through a seeder without difficulty and in the experiments came up satisfactorily, while check rows were badly injured. Examinations later showed that the wireworms were present close to the seed but that they did not molest the seed itself, apparently being repelled by the application. It is by all means advisable, as pointed out above, to avoid trouble, if possible, by planting on land free from these pests those crops which can not be protected. A rotation of crops will do much to prevent this pest becoming unduly abundant, since it is primarily a grass-feeding species and requires some three years to complete its life cycle.

Harlequin cabbage bug (Murgantia histrionica Stal.). This insect, though well known as a common and injurious pest of cruciferous plants in the South, is rare in the northern states. Dr John B. Smith, in his list of Insects of New Jersey, published in 1899, reports its occasional presence in destructive numbers in southern New Jersey. We find on referring to our records, that in the report of this office for 1900 this species was reported from Elmira and Oswego, and Jamaica, L. I., the two latter localities being brought to our notice through the courtesy of Dr L. O. Howard. The past summer specimens of this bug were received from Mr Roy Latham at Orient Point, the extreme eastern end of Long Island. This latter record is interesting, showing the continued presence of the insect on Long Island and its extension over practically all of that section. It is hardly probable that this species will ever become abundant enough in New York State to cause material injury.

SHADE TREE INSECTS

Elm leaf beetle (Galerucella luteola Müll.). This pest continues to attract a great deal of notice on account of its serious depredations, especially in the Hudson valley. Numerous trees almost defoliated or with badly skeletonized leaves were rather common in the cities and villages of the valley from New York city northward to Stillwater and vicinity. A noteworthy feature was a report of serious injury accompanied by numerous specimens received from Mr Frank T. Clark of Ticonderoga. This appears to be the northermost record for the occurrence of these beetles in numbers in New York State. The injury by this pest was severe in the Mohawk valley at Schenectady and locally at Amsterdam. The elms of Ithaca, judging from reports received, have also been seriously injured.

The season of 1910 has been remarkable in the Hudson valley because of the prolonged drought following a scarcity of water the preceding season. This condition undoubtedly had an important influence upon the thrift of the trees, a fact easily demonstrated by examining elms where there were practically no elm leaf beetles. The foliage on many of these trees was thin and, though not skeletonized, was in a far from satisfactory condition. As a consequence, trees suffering from drought and exposed to a further depletion of energy through the attacks of a voracious leaf feeder, were more seriously affected than usual by this latter injury. Many trees will go into the winter with a reduced vitality, and it is to be expected that considerable dead wood will be found another spring. All such trees should receive special attention next season. The dead wood should be removed and this possibly supplemented by judicious pruning, the exposed cut surfaces being protected from the weather by applications of tar, paint or similar materials.

Most important of all, these trees should also be protected from the continued ravages by the elm leaf beetle. Experience has demonstrated time and again the entire practicability of controlling this pest by thorough and timely applications of an arsenate of lead (15 per cent arsenic oxide) to the under surface of the foliage at about the time the leaves are three-quarter to full grown, something depending upon the number of trees to be treated. The most effectual spraying for this pest must be done between the middle of May and the 25th of June. It is practically useless to apply poison after the grubs commence to forsake the trees unless the foliage has been so thoroughly skeletonized that the majority of the leaves will drop and a new crop appear. Spraying for the protection of this new foliage is always justified by results, and the late applications may also be of service in protecting foliage which had escaped injury earlier in the season. There are three important factors to be observed in this work if one would secure satisfactory results; namely, timeliness, the securing of proper material and its thorough application to the under surface of the leaves. Inattention to any one of these details will result in unsatisfactory work, if not in a complete failure in the efficacy of the operations. Our modern high power spray apparatus makes it possible to treat such trees rapidly and without great expense. These methods, if carried out faithfully, should insure practical immunity from serious injury and enable the elms to regain some of their normal vigor. It is perhaps unnecessary to add that so far as the elm leaf beetle is concerned, the application of sticky bands to the trunks of the trees, or the scraping off of the rough bark, are of so little value as not to deserve serious consideration at the hands of the practical man.

Bag worm (Thyridopteryx ephemeraeformis Haw.). Numerous half grown larvae of this species were received June 3, 1910 from Mr M. C. Albright, who took them at New Baltimore. This, as has been previously pointed out, is near the northern limit of this species.

Sugar maple borer (Plagionotus speciosus Say). The presence of this pernicious borer at Fulton was recorded in our report for last year. An examination the present season shows that the destructive work has continued without abatement, there being several centers of infestation. One is near the northwest corner of the park and is marked by a nearly dead maple tree having a trunk diameter of about 18 inches and showing approximately fifty of the characteristic exit holes, some of them being a year or more old. There has been a spread from this center of infestation upon either side and the existence of adjacent trees is threatened. Several similar centers were found on Cayuga street, namely, a row of four dead or dying magnificent trees between Second and Third streets, another on South Third street beside the church facing Cayuga street, and a fourth at the corner of Cayuga and Fourth streets. The above probably represents only a portion of the maples seriously affected by this pest. A complaint accompanied by specimens shows this insect to be destructive to the sugar maples at Carthage, and at Palmyra.

Elm scurfy scale (Chionaspis americana Johnson). This species is more or less abundant upon elms throughout the State. A very badly infested limb was brought in May 10, 1910 by Mr W. B. Landreth of Schenectady, with the statement that the tree, set some twenty years previously, and with a trunk diameter of about 15 inches, was in poor condition. Last year many of the young leaves dropped when they were partly out and another crop developed. The tree is said to be in a somewhat better condition this year, though apparently far from vigorous. Judging from the specimen submitted, this scale insect appears to be responsible for the major portion of the injury, since the twig is well spotted with scales and numerous crawling young are to be seen upon the bark.

False cottony maple scale (Phenacoccus acericola King). There has been an unusual number of complaints concerning this insect, the majority coming from Mt Vernon and vicinity, though reports of injuries were received from Newburgh and Batavia. Personal observation showed that this pest was somewhat abundant on trees at Newburgh and, to a less extent, at Hopewell Junction.

This species is easily distinguished from the older and better known cottony maple scale[1] by the fact that it occurs in conspicuous felted masses upon the trunks of infested trees and also forms large, cottony aggregations on the foliage (fig. 6), two situations where the cottony maple scale is never found with its contrasting white covering.

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[1] Pulvinaria vitis Linn.

The full-grown females of the false maple scale may be found on maple leaves in summer and are then about one-quarter of an inch in length and with a slightly less transverse diameter. The parent insects are concealed by an oval mass of powdery, slightly stringy wax within which is the female and her eggs (frequently 500 in number), the former occupying the anterior portion and her body constituting about one-quarter the bulk of the mass. The young remain on the leaf after emerging from the eggs, unless it is too crowded, in which event they crawl down the petiole and seek nourishment on healthy foliage. The males, on attaining full growth, become restless and wander over the trunk and limbs for from seven to ten days, finally secreting themselves beneath or

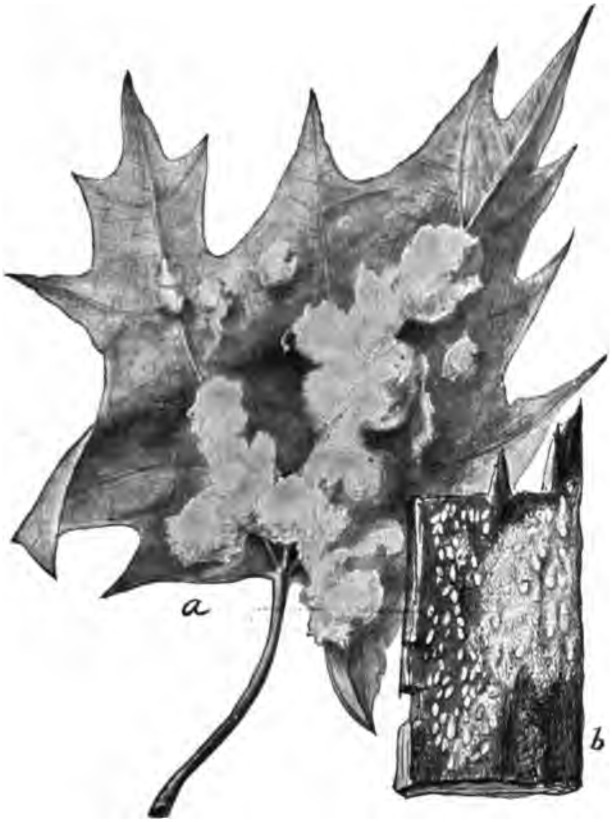

Fig. 6 False cottony maple scale. *a*=adult females on leaf; *b*=young females and males on bark. Natural size. (After Howard. Insect Life. 1894. 7:235)

upon the rougher outer bark, form the conspicuous felted masses frequently seen, and therein transform to pupae. There are probably three generations in this latitude, the winter being passed by the young in crevices of the larger limbs. Observations at Poughkeepsie last fall showed that crawling young were very numerous October 4th. Affected trees drop their foliage earlier in the fall while that of others is still green and at least moderately vigorous.

This scale insect can be controlled by thorough applications, in winter or early spring, of a contact insecticide, using 1 pound of whale oil soap to a gallon of water. The kerosene emulsion, the standard formula diluted with 4 parts of water, has been found very effective in controlling the cottony maple scale and would doubtless prove equally efficient in the case of this species. Several oil preparations now on the market under various trade names have also been employed successfully.

FOREST TREE INSECTS

Large black carpenter ant (Camponotus herculeanus Linn.). The work of this large wood ant is rather common in the Adirondacks where it appears to display a marked partiality for balsam trunks, excavating them in a very characteristic manner as illustrated and pointed out by the author several years ago.[1]

An examination of the balsam shows at once that the ants had eaten out the softer portions of the wood, and left in large measure the harder parts formed toward the end of the season when growth was comparatively slow and the wood correspondingly firmer. This style of galleries was also compared with the very irregular and markedly different work of this species in elm. The latter is undoubtedly due to the fact that the fibers of elm wood interlace and, as a consequence, there is very little difference in the relative hardness of the wood laid down at different seasons of the year. The past season we secured from Silas H. Paine of Silver Bay an exceptionally fine specimen of the work of this species in poplar. By reference to plates 19, 20, it will be seen that the method of excavation is somewhat intermediate between that obtaining in poplar and the elm and presumably explainable by the nearly uniform, soft texture of poplar wood. The general plan shows a series of horizontal chambers connected by numerous more or less regular, perpendicular galleries traversing the heartwood. Portions of the galleries strikingly suggest the ruins of an ancient castle. This ant occasionally establishes itself in houses and, if allowed to multiply unrestricted, may seriously weaken the timbers.

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[1] 1905 N. Y. State Mus. Mem. 8, 1: 90, pl. 31.

Abbott's pine sawfly (Lophyrus abbotii Leach). This rather common and occasionally destructive species was unusually abundant in the foothills of the Adirondacks last summer. This insect was reported as defoliating pines in August, by Mr Andrew Lackey of Johnsburgh and by Messrs Wesley Barnes and J. W. Wilson of Olmstedville. Mr Lackey stated that the insects had injured quite a number of his pines, while a personal examination showed that this sawfly was abundant on a comparatively few trees at Olmstedville, being restricted to some 40 or 50 pines in the creek bottom. One of these trees was nearly 50 feet high and so badly injured that practically all the foliage was destroyed, while at its base were to be found thousands of half-grown larvae unable to secure nourishment necessary to the attainment of their normal growth. Many cocoons were observed in the needles at the base of this tree August 9th and 10th. None appeared to be of normal size, since they were from one-third to even one-fourth smaller than cocoons made by larvae received early in August from Mr Lackey. The other affected pines at Olmstedville were all small, rarely more than 25 or 30 feet high and none of them were so badly injured as the one described above. In some instances there were numerous full-grown larvae, specimens of which were secured. It was also stated that this insect was at work on near-by pines, though a cursory examination revealed no evidence of their operations. There were signs here and there of pines being injured, presumably by this insect, along the line of the Delaware and Hudson Railroad running from Corinth to North Creek. Rev. G. H. Purdey reported under date of August 22d, similar injury here and there to pines in the vicinity of Warrensburgh. No adults developed last season from the cocoons collected in August. There appears to be but one generation annually.

The destructive caterpillars, when full-grown, are nearly an inch long and easily recognized by the black head and the yellowish white body ornamented with two rows of oblong, square, black spots down the back. On each side there is another row of about eleven black, nearly square spots, a little longer than broad. These false caterpillars, when disturbed, throw back the head and move the upper portion of the body in a manner very similar to that of caterpillars belonging to the genus Datana. The larvae spin their brownish, oval cocoons among the leaves. Dr Riley states that some of the flies appear early in spring, while others do not issue till the latter part of June. One parasite, Limneria lophyri Riley, has been reared from this sawfly. This species may occur upon both white and hard pines from midsummer till late fall. The parent insects deposit their eggs in little slits in the leaves. They are rather stout, 4-winged sawflies, the common name being given because of the sawlike appendage at the tip of the female abdomen. This sex has a wing spread of about two-thirds of an inch, is honey-yellow, the head and thorax being a little darker, the latter and the abdomen being slightly marked with black. The male has a wing spread of about one-half of an inch, and the body is black, except the yellowish underside and the tip of the abdomen.

Experience has shown that this species is most likely to injure young pines, consequently it is well, where feasible, to watch for the appearance of the pests in such plantings and if circumstances warrant, adopt repressive measures. Many larvae can be jarred from small trees by vigorous shaking and their ascent prevented by an application to the trunk, of a sticky band such as tree tanglefoot. There is no doubt but that thorough spraying with a poison, preferably arsenate of lead (15 per cent arsenic oxide) would destroy these leaf feeders. It might pay to resort to such practices where only a few trees are badly infested, largely for the purpose of reducing the likelihood of more extended subsequent injury.

Spotted Cornus sawfly (Harpiphorus tarsatus Say). This greenish yellow, black spotted sawfly was received September last from Joseph H. Dodge of Rochester, through the State Department of Agriculture, accompanied by the statement that the larvae were very abundant and destructive to Cornus mascula. This sawfly appears to be a rather common form and widely distributed, since it has been recorded from Canada, Massachusetts, Connecticut, Indiana and West Virginia. The eggs, according to Dr Dyar, are deposited under the lower epidermis through a slit cut from above. They are close to the midrib in a long line, the cuts united. One edge of the swelling is on the midrib or large vein, the other parallel to it but wavy and composed of numerous saw cuts. The recently hatched larva is nearly colorless, with a slightly fuscous head. The latter becomes darker as development progresses and eventually black, while the body remains whitish or pale olivaceous, the black marks appearing in the sixth stage. The following description was drafted from full-grown living larvae:

Larva. Full-grown. Length 2.5 mm. General characters: head black, body greenish yellow with subdorsal and sublateral rows of black spots, venter orange-yellow.

Head subglobose, shining black, the single ocellus on each side, black. Antennae with the basal segment whitish transparent, the four distal segments with a yellowish tinge. Labrum yellowish; mandibles reddish basally, shining black apically; maxillary palpi, labium and labial palpi whitish transparent. Body segments 6 annulate dorsally, the first thoracic segment with the anterior two or three annulae mostly yellowish or yellowish orange; dorsum mostly yellowish green. The subdorsal row of black spots is composed of two on each segment, the anterior one extending over three annulae, the posterior on two, the first being approximately subquadrate, the second transverse and with a length nearly twice its width; the lateral row composed of large, irregular, quadrate spots, one to each segment and extending over four annulae. Anal plate with submedian, quadrate, black areas anteriorly and a median, quadrate, black area posteriorly, the remainder yellowish. Spiracles oval, brownish black, the subspiracular and ventral area orange-yellow; true legs pale yellowish, slightly fuscous apically; prolegs on abdominal segments 2 to 8 and 10.

The parent sawfly has been described by Norton[1] as follows:

Length, male, 0.32. Br. wings 0.52 inch. Length, female, 0.60. Br. wings 1.12 inch.

Female and male. Body long and stout; antennae longer than base of thorax, stout, flattened, serrate, black, with the four apical joints white; head as in E. varianus, with the sutures at sides of ocelli widened below and inclosing the base of antennae; nasus deeply incurved, rugose; labrum white, its edge rufous; tegulae piceous or yellow; scutel in middle white: legs black; all the trochanters, the apical half of four anterior tibiae and their tarsi and the posterior tarsi, except first joint, white (sometimes the first joint also). Wings smoky hyaline, base of stigma white; second recurrent nervure a little removed from intersection of second and third submarginals.

Blue Cornus sawfly (Harpiphorus versicolor Norton). Numerous specimens of these sawfly larvae were received from Dr L. F. Rinkle of Boonville, September 18th, accompanied by the statement that they had entirely stripped one bush of Cornus alternifolium. This sawfly appears to be less abundant than the preceding, having been recorded from Illinois and New Jersey. The eggs, according to Dr Dyar, about three in number, are laid side by side under the lower epidermis from above, forming a short row nearly parallel to a side vein. The young larva has a pale brown head and a curled, whitish body, the latter becoming well covered with a white, mealy secretion in the third stage. The following description of the full-grown larva was drafted from living specimens.

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[1] 1867 Norton, Edward. Amer. Ent. Soc. Trans. 1:231.

Larva. Full grown. Length 2 cm. This species is most easily recognized by the black head and the mostly black, transversely blue-banded dorsum, the ventral surface being orange-yellow.

Head shining black, the one lateral ocellus brownish black. Antennae short, fuscous yellowish, ventral fourth of head mostly fuscous yellowish including the labrum. Mandibles brownish black apically; labium, maxillary and labial palpi fuscous yellowish. Body segments irregularly 6 annulate dorsally, the first thoracic segment with the anterior two or three annulae orange-yellow, the others with the first three and the fifth annulae shining black, the fourth being light blue dorsally and subdorsally, black laterally and the sixth light blue. Anal plate black and with a few short spines or hairs. Spiracles oval, brownish black, the subspiracular area and venter orange-yellow; true legs yellowish transparent, fuscous apically; prolegs on abdominal segments 1 to 7 and 10.

The parent insect has been described by Norton[1] as follows:

Length 0.40. Br. wings 0.80 inch.

Female. Body long and not very stout, color chestnut-red; antennae not longer than base of thorax, thick, serrate beneath, third joint but little longer than fourth, the two basal joints piceous, the three next black, remainder white; face as in E. varianus, not so much depressed below antennae; clypeus not deeply notched; a black spot from below antennae to summit; labrum and tegulae white; thorax black, scutel black, basal plates rufous, legs rufous, trochanters and tarsi white; coxae, basal tip of the four anterior femora and the apex of posterior tibiae blackish; wings smoky, base of stigma white; second recurrent nervure a little removed from junction of first and second submarginal cells.

Spotted pine weevil (Pissodes notatus Fabr.). Seedling pines shipped from Oudenbosch, Holland and submitted for examination April 13, 1910 through the State Department of Agriculture, had the terminal shoots infested by a number of active, though full-grown larvae of this species. Pupation occurred shortly thereafter and several adults were reared in early May. The operations of this European form were very similar to those of the common American white pine weevil, Pissodes strobi Peck, though in this instance at least, there was a marked difference in the life history, since this imported insect appears to winter as a larva.

This European species, kindly identified by Dr A. D. Hopkins of the United States Bureau of Entomology, is about one-third larger than our native Pissodes strobi Peck and is most easily distinguished therefrom by the indistinct ochreous red coloration and the smaller, more inconspicuous, whitish spots on the distal third of the wing covers. Dr Hopkins states that this weevil is a very important enemy of the pine in Europe, and that owing to the danger of its becoming a serious pest in this country, every precaution should be adopted to prevent its obtaining a foothold in America. In passing, we would call attention to the fact that Ratzeburg has recorded 29 species of parasitic Hymenoptera living at the expense of this weevil. Nevertheless, it would certainly be much safer to exclude seedling pines, particularly as there is also grave danger of importing a very destructive fungous disease.

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[1] 1867 Norton, Edward. Amer. Ent. Soc. Trans. 1:230.

Snow-white linden moth (Ennomos subsignarius Hübn.). This insect, which has come into prominence during the last three years on account of its extended depredations in the Catskills and, to a lesser extent, in the Adirondacks, was again abundant in at least limited sections of the Catskills. A number of eggs of this species were brought in March 28th by Mr Edward Thomson of Frost Valley, Denning, Ulster county, accompanied by the statement that they were numerous in his vicinity. Mr Edmund Platt of Poughkeepsie stated, under date of July 16th, that the caterpillars of what were undoubtedly this species, were very abundant just southeast of Shokan, also in Ulster county, at an elevation of about 2000 feet. The foliage was badly eaten and the caterpillars were observed hanging from the leaves in every direction. Evidently they had cut off many leaves, pieces of which were strewn on the ground. Beeches, maples, moosewood and apparently every variety of forest tree in that vicinity, were eaten. The caterpillars were so thick as to make it very disagreeable walking through the woods. There were a few at lower elevations and again near the top of the mountain. Miss Maud M. Meyer stated, under date of July 20th, that the maple trees in the vicinity of Bushnellsville, Greene county, were being destroyed by caterpillars, undoubtedly this species. A specimen of the moth was transmitted by Dr James C. Ayer of Glen Cove, under date of July 22d, this gentleman fearing it might be the much more dangerous brown tail moth. This report from Long Island shows that the insects were probably somewhat abundant there, while personal observation disclosed the fact that they were to be found in small numbers July 22d at Milton and Marlborough, and also on the electric cars at Hudson and near Valatie. Apparently this pest is less numerous than it was last year and it is to be hoped that natural enemies, birds in our estimation occupying a prominent place in this respect, will soon reduce their numbers so greatly as to prevent extensive injury in the future.

There should be no difficulty in distinguishing this species from the brown tail moth mentioned above. The parent insect is a rather slender-bodied, usually snow-white moth (pl. 21, fig. 2) having a wing spread of about one and one-half inches, the female being a little larger. It is decidedly more slender than the brown tail moth and the latter, though flying at about the same time, may be instantly recognized by the characteristic bright reddish brown tuft on the tip of its abdomen.

The eggs of the snow-white linden moth are deposited in irregular masses (pl. 21, fig. 1) about half an inch in diameter, each containing from 50 to over 100 eggs. The individual eggs lay at an oblique angle to the supporting surface, are about 1 mm. in length, barrel-shaped, light brown and with a conspicuous salmon-colored ring at the extremity.

The full-grown caterpillar has a length of about two inches. The head is a dull reddish or yellowish brown, distinctly broader anteriorly, the clypeus sunken, yellowish brown, the labrum pale yellowish with a few conspicuous yellowish setae, while the antennae are short, the basal segment yellowish, the second segment prolonged, reddish yellow, narrowly yellowish at the extremities and with a few coarse setae apically. The mandibles are reddish brown, fuscous apically and irregularly bidentate; labial palpi triarticulate, mostly pale yellowish; spinneret concolorous. The thoracic shield is darker than the head and distinctly fuscous along the margins. The body is mostly a dull brownish black, the anal plate and the anal prolegs being yellowish brown. There are irregular, yellowish markings along the sublateral lines, they being represented by inconspicuous dots on the second and third thoracic segments. These markings are so thick on the first abdominal segment of some specimens as to give the appearance of short sublateral lines extending most of the length of the segment. On the third abdominal segment the yellowish markings are distinctly produced laterally and toward the median line, forming a pair of submedian irregularly oval, yellowish marks very suggestive of tubercles. These sublateral marks are indicated on the remaining segments only by inconspicuous dots, a pair on the anterior and posterior annulets of each segment, the yellow markings becoming a little thicker and more irregular on the 11th, 12th and 13th segments.

The true legs are a variable yellowish and reddish brown, the distal segments being somewhat darker. The first pair of prolegs are dark brown basally and yellowish brown apically; the anal prolegs are mostly yellowish brown; the venter is nearly the same color as the dorsum, except that part between the prolegs which is variable yellowish green and yellowish brown.

The pupae occur among the leaves, being sheltered in very light, thin, yellowish brown cocoons. The pupa is about one inch long, the general color being a yellowish brown irregularly spotted with black. The antennae, legs and wing sheaths are closely fused and extend to the tip of the fourth abdominal segment; the terminal segment is pale yellowish or yellowish straw; the cremaster is composed of an irregular group of four stout, dark brown, recurved hooks, two distal, two subapical and then two pair of more slender ones, the more distal being lateral and the others dorsal.

Control measures. This species, as stated before, is not an important shade tree pest, since the English sparrow can usually be relied upon to keep it within bounds. The control of this insect in woodlands is a much more serious problem and must depend in large measure upon natural enemies, such as parasites and especially our native insectivorous birds. These latter should be protected in every feasible manner.

Birch leaf skeletonizer (Bucculatrix canadensisella Chamb.). This small leaf feeder was generally abundant, though not exceptionally numerous, upon the white birches at Kinderhook. This occurrence is probably the western border of a severe outbreak in New England, recently recorded by William R. Thompson[1] and comprising areas in Connecticut, Massachusetts, New Hampshire and Maine, at least. Nine years ago this species was exceedingly numerous in the vicinity of Albany, skeletonizing practically all of the foliage of our ordinary white or gray birch, Betula populifolia. The full-grown caterpillar is only about one-fourth of an inch long, light green or yellowish green and most easily recognized in association with the peculiar, oval or circular, whitish, moulting cocoons about one-twelfth of an inch in diameter. The larvae may be found upon the trees in August or early September, feeding upon the soft parenchyma of the leaf and, when numerous, skeletonizing the foliage. The winter is passed in a narrow, brownish yellow, ribbed cocoon about one-fifth of an inch long. The parent moth is a delicate, bright brown insect with a wing expanse of three-eighths of an inch. The wings have two subtriangular blotches on the inner margin which, when these organs are closed, form two white dorsal saddles, while, in addition, there are three silvery white bars which run from the outer edge about half way across the wing obliquely toward the apex. Behind the anterior white saddle there is a tuft of raised, black scales and several similar ones at the apex of the fore wings. This species can hardly be considered as of much economic importance, since its food plant has very little commercial value.

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[1] 1910 Journ. Econ. Ent. 3:436.

Beech tree blight (Pemphigus imbricator Fitch). This rather common insect is easily recognized by the woolly plant lice or aphids occurring in masses on the under side of the limbs. This species is quite resistant to cold, since it was observed the latter part of October, 1903, after the temperature had been quite cold and while an inch of snow was to be seen on adjacent hillsides. It is a widely distributed species, having been reported from various parts of the State. It was undoubtedly this species which was reported by Dr D. B. Miller, Jersey City, N. J., under date of October 31st, as being abundant on the lower small branches of young beech trees in Delaware county. Mr George C. Wood, writing from the Trenton camp grounds at Barneveld, Oneida county, August 22d, stated that they were having a great deal of trouble with the insect, adding that every beech tree was covered with it and that it was fast killing the branches. Mr Frank A. Schmidt of Ilion, writing under date of September 14th, states that practically all of the beech trees in that vicinity were affected by this pest. The insects were so numerous that the lower branches of nearly all the beech trees were completely covered with the white, woolly aphids. These limbs seemed to have lost all vitality, since those half an inch in diameter could be bent and twisted like a piece of rope.

The great abundance of this insect over so large an area appears to be unusual for New York State. Owing to the fact that it occurs upon forest trees, active remedial masures are ordinarily impractical. We must depend in large measure upon natural enemies. One of the most important of these is the caterpillar of a native butterfly, Feniseca tarquinius Fabr. The mother insect deposits her eggs upon the twigs of beech, alder etc. in the midst of colonies of woolly aphids. The caterpillars, upon hatching, spin a thin web and devour many of the plant lice, completing their growth within thirteen days.

Silver fir aphid (Chermes piceae Ratz.). Nordmann's firs received from Europe the past season and submitted for examination by the State Department of Agriculture, were infested by a Chermes which was provisionally determined as the above named species by Dr A. D. Hopkins of the United States Bureau of Entomology and the writer. An examination of the literature shows that there may be a question as to the specific identity of this European form. We have used the above specific name and given illustrations of the insect (pl. 18, figs. 1, 2), since our material was not sufficiently abundant to permit of an authoritative identification. This form may prove, as has been stated in the case of at least one Chermes on fir, to be a synonym of Chermes funitectus Dref.

Apparently, this is the first record of the introduction of the species into America. A Chermes discussed under this name by Gillanders is recorded by him as very destructive to young silver firs, comparatively young specimens of Abies nordmanniana and even fairly old trees of Abies nobilis. He states that young silver firs in nurseries are often killed outright by this insect. The data at hand justifies us in considering this species a dangerous form which should be excluded, if possible.

MISCELLANEOUS

Blow fly (Calliphora viridescens Desv.). Several larvae and two pupae of this species were received under date of July 30, 1910, from Mrs H. B. Reist of Schenectady, accompanied by the statement that they had been found under a rug in a study on the second floor of a new house. Subsequent correspondence developed the fact that the rug had been sent a month earlier to a vacuum cleaning establishment located over a stable. There appears to be no other probable explanation for the occurrence of the larvae in this strange environment, other than that they may have worked into the fabric from some adjacent nitrogenous material while at the cleaning establishment, since the common blow fly larvae, as is well known, thrive in fresh or decaying flesh, cheese or nitrogenous vegetables. The parent flies, kindly determined by Mr D. W. Coquillett of the United States National Museum, appeared August 10th. They are about one-third the size of the more common blow fly, Calliphora vomitoria Linn., with a somewhat similar steel-blue or violet-blue abdomen, though easily recognized by the grayish black thorax in marked contrast to the duller black thorax of C. vomitoria. It is perhaps needless to add that both of these blow flies are distinguished from the rather slender, grayish banded, exceedingly common house fly by their larger size, greater stoutness and violaceous coloring.

Stable fly (Muscina stabulans Fall.). This rather common fly was reared last May from larvae in bee comb found in association with a few small beetles which live in decaying animal matter. This record is not unprecedented, since, according to Dr Howard, this species has similar habits in Europe. The maggots of this fly usually occur in decaying vegetable matter, fungi etc., though they have been reported as living in cow dung, and Megnin records finding puparia in the mummified bodies of children. This species was captured at Washington several times on human excrement.

Saturnia pavonia Linn. One specimen of the dark reddish brown cocoon of this Bombycid was found on nursery stock at Rochester. The cocoon is 3.5 cm. in length, 2.5 cm. in diameter and with one end somewhat produced and partially open. The moth, which was easily reared, has a wing spread of 7.5 cm., is smaller than our well known Calosamia promethea Drury, and the coloring is mostly in shades of gray with distinct ocellate spots on both the anterior and posterior wings. There should be no difficulty in excluding this rather large species.

Insects and paper. Three years ago, through the courtesy of the A. T. de la Mare Printing & Publishing Company of New York, we received a large sheet of paper badly disfigured, though just from the calendering rolls. An examination showed that a May or June beetle had been caught in the heavy rolls and literally crushed into the paper, its body fluids making a smear some 12 inches long. A most interesting feature was the preservation of the hard parts, especially the legs and antennae, so perfectly that there was no difficulty in referring the victim to the genus Lachnosterna. An equally interesting specimen of this kind of work was discovered in a recent publication. The victim this time was a crane fly. The paper presented substantially (pl. 17, fig. 2) the same appearance as noted above, portions of the insect remaining even after the paper had been subsequently printed upon and bound. These accidents suggest the possibility of a novel ornamental card or sheet made by rolling into the paper the delicate wings of certain common insects, thus obtaining an effect impossible from purely artificial methods.

Agromyza melampyga H. Lw. Numerous specimens of this small, yellowish and black marked fly were reared the latter part of May 1910 from walking-leaf, Camptosorus rhizophyllus, collected at Hudson Falls May 16, 1910 by Stewart H. Burnham, assistant to the State Botanist. The infested leaves presented a peculiar appearance at that time, since many of them were margined on the upper surface with a more or less linear series of equidistant, brownish elevations which, upon examination, proved to be the tips of the puparia. The larvae evidently live in communal mines and, when full-grown, cut a slitlike orifice and transform so as to leave the brownish bispinose apex of the puparia protruding from the orifice. A series of these presents an unique appearance. The puparium is about 2 mm. long, nearly 1 mm. wide, rather stout, a variable reddish brown, the exposed tip being a little darker. Apically there is a pair of dark brown, short, stout, chitinous, recurved processes. One parasite, kindly described through the courtesy of Dr L. O. Howard, by Mr J. C. Crawford as Sympiezus felti, was reared at the same time the flies issued.

The parent insect has been described[1] by C. W. Johnson under the name of A. flaviventris as follows:

> Head light yellow, occiput black; antennae yellow, aristae black. Thorax light yellow, with a large black dorsal spot, which extends narrowly from the cervix, expanding dorsally, with lobes above the humeri and base of the wings; scutellum yellow, metatarsus black. Abdomen dull light yellow, terminal segment black; halteres and legs yellow. Wings grayish hyaline. Length of the larger specimen 2 mm.; the smaller one 1.5 mm.

These specimens were taken at Niagara Falls. It has been listed by Smith from New Jersey, recorded by Loew from the District of Columbia and identified from the Bahamas.[2] In addition this species has been reared at Washington, D. C., by Coquillett[3] from leaf mines in a species of cultivated Philadelphus and also from the common Plantain, Plantago major.

Coquebert's Otiocerus (Otiocerus coquebertii Kirby). The slender, yellowish or yellowish red marked insects belonging to this species and resembling somewhat in general appearance Caddis flies, are rather common and widely distributed, having been recorded from Canada, south to Texas and, in addition, from several Eastern and Middle States. The delicate adults have been taken upon a variety of trees, namely hickory, oak, beech, maple and also on grape.

This attractive insect belongs to the Hemipterous family Fulgoridae, noteworthy because of the large exotic lantern flies. The Brazilian Laternaria phosphorea has a wing spread of fully 6 inches and an enormous miter-shaped head as long and nearly as thick as its body. The subfamily Derbidae to which Otiocerus is referable, is a group of moderate extent, comprising some of the most beautiful and delicate forms found in the Hemiptera. The head in this subfamily is generally produced forward, sometimes extremely compressed and with the sides prominently carinate as is the case with Otiocerus.

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[1] 1902 Can. Ent. 34:242.

[2] 1908 Psyche 15:80.

[3] 1898 U. S. Dep't Agric., Div. Ent., Bul. 10 n.s., p. 77.

The adult of this species when at rest is nearly half an inch long to the wing tip (the length of the body is only three-sixteenths of an inch). It rests with the long, delicate wings folded together parallel and thus presents a general resemblance to a Caddis fly. It may vary in color from a nearly uniform, pale yellowish or yellowish green in the one female obtained to a yellowish green marked with strongly contrasting red or reddish brown in the males as follows: The broad stripe extends from the tip of the head on either side to the bronzy or blackish eyes, is continued by broken spots just below and behind these organs, and a larger, reddish area laterally on the pronotum and on the anterior portion of the mesonotum, and may be followed as an oblique stripe from the base of the fore wing to its posterior margin near the distal third, which latter is marked by a slight marginal fuscous line. From this point the reddish markings are produced in a more or less broken, marginal line to the anal angle, there being a small subapical branch near the distal fifth and a much more conspicuous one at the distal third and extending as an irregular, oblique mark to the anterior distal angle. There is, in addition, an irregular, reddish mark near the middle of the wing; the hind wings are nearly colorless. The head is strongly compressed, being greatly produced anteriorly and with strong lateral dorsal carinae. The male antennae are a variable reddish and remarkable, since each is composed of three irregular branches apparently arising from a basal segment, the anterior distinctly capitate. The antennae of the female are but two-branched, the anterior one slightly capitate and apically with a bristle nearly as long as the branch. The ovipositor is short, the organs uniting to form a conical apex. The legs are a nearly uniform yellowish transparent. The pale yellowish abdomen extends only to about the middle of the wings and is variously shaded with reddish. The male is easily recognized by the conspicuous pair of yellowish transparent, inflated, strongly curved clasping organs.

A colony of nymphs of this species were taken at Poughkeepsie, N. Y. May 12, 1910 under the dead bark of a stump, possibly beech. The insects moved slowly, and eleven days later adults emerged.

Nymph. Length one eighth of an inch, width about one-sixteenth of an inch. Color an obscure brown, the sutures yellowish brown; the head small, partially concealed by the prothorax; the wing pads short, extending to the third abdominal segment, each of the latter with a series of obscure tubercles, fuscous basally, lighter apically; along the anterior third the head and thorax apparently with similar though more rudimentary structures. Legs a yellowish brown.

It is remarkable that such an apparently large adult should develop from so small a nymph. A partial explanation is found in the fact that the abdomen of the adult is much shorter than one would be led to expect from the length of the wings.

PUBLICATIONS OF THE ENTOMOLOGIST

The following is a list of the principal publications of the Entomologist during the year 1910. Fifty are given with title[1], time of publication and a summary of the contents of each. Volume and page numbers are separated by a colon, the first superior figure gives the column and the second the exact place in the column in ninths: e. g. $75:9^{15}$ means volume 75, page 9, column 1 in the fifth ninth, i. e. about one-half of the way down.

Grain Weevil. Country Gentleman, Jan. 6, 1910, $75:9^{15}$.

A summary discussion of repressive measures.

Two New Cecidomyiidae. Entomological News, Jan. 1910, 21:10–12

Lasioptera tripsaci and Cecidomyia opuntiae described.

Deformed Apples. Country Gentleman, Jan. 27, 1910, $75:82^{16}$

A brief discussion of the work of the tarnished plant bug, Lygus pratensis Linn. The plant louse outbreak of 1909 is commented upon and control measures discussed.

Corn, Cutworms and Ants. Country Gentleman, Feb. 3, 1910, $75:107^{25}$

A brief discussion of methods for controlling various cutworms and ants in cornfields.

Scale and Fungus Attacks. Country Gentleman, Feb. 3, 1910, $75:107^{88}$

The San José scale, Aspidiotus perniciosus Comst. is identified and remedial measures briefly discussed.

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[1] Titles are given as published and in some instances they have been changed or supplied by the editors of the various papers.

Observations on the House Fly. Economic Entomology Journal, 1910, 3:24–26

Summary of experiments showing that the house fly, Musca domestica Linn. does not invade darkened apartments.

Some Tree Crickets. Country Gentleman, Feb. 24, 1910, 75:182^{27}

Oecanthus niveus DeG. appears to be limited mostly to apple trees, while O. nigricornis Walk. and O. quadripunctatus Beutm. have been recorded as the species injurious to raspberry and blackberry bushes. Preventive measures are discussed.

Control of Flies and Other Household Insects. New York State Museum Bulletin 136, 1910, p. 1–53 (Issued Feb. 26, 1910, a revised and extended edition of Bulletin 129).

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Work with the Codling Moth. Country Gentleman, Mar. 3, 1910. 75:230^{11}

A summary comparison of results obtained against codling moth, Carpocapsa pomonella Linn., between coarse and fine sprays and one, two and three applications. One thorough application of a mist spray gave 98–99 per cent of worm-free fruit.

Struggle with the Scale. New York Apple Orchards Saved. Rural New Yorker, Mar. 5, 1910, 69:256^{11}

A summary account of the work against San José scale, Aspidiotus perniciosus Comst., with special reference to the success of Mr W. H. Hart in his old orchard.

Bleeding Elm — Beetle. Country Gentleman, Mar. 10, 1910, 75:245[42]

Discusses the causes of bleeding in trees and gives remedy for the elm leaf beetle, Galerucella luteola Müll.

The Apple Maggot. Country Gentleman, Mar. 17, 1910, 75:271[25]

A general discussion of Rhagoletis pomonella Walsh, with reference to work against fruit flies in South Africa with poisoned syrups.

Spraying for Codling Moth. Country Gentleman, Mar. 31, 1910, 75:322[27]

A summary discussion of remedial measures for Carpocapsa pomonella Linn., with special reference to results obtained with the single spray and with observations on prepared insecticides.

Schizomyia ipomoeae n. sp. Entomological News, April, 1910, 21:160–61

A description of this West Indian species reared from the flower buds of Ipomoea.

Methods of Controlling the House Fly and thus Preventing the Dissemination of Disease. New York Medical Journal, April 2, 1910, 91:685–87

A summary account of the house fly, Musca domestica Linn., with special reference to control measures.

Oyster-Shell Scale. Country Gentleman, April 7, 1910, 75:347[15]

Remedial measures for Lepidosaphes ulmi Linn.

Spraying for the Codling Moth. Economic Entomology Journal, 1910, 3:172–76

Summary of experiments for the control of Carpocapsa pomonella Linn., and emphasizing the effectiveness of one thorough application of poison.

Leopard Moth. Country Gentleman, April 21, 1910, 75:396[45]

Brief economic account of Zeuzera pyrina Fabr., with special reference to control measures.

Peach Twig Borer. Country Gentleman, May 12, 1910, 75:470[32]

Summary economic account of Anarsia lineatella Clem.

Borer. Country Gentleman, May 26, 1910, 75:517[26]

A brief discussion of the peach borer, Sanninoidea exitiosa Say and methods of controlling it.

Cutworms in the Garden. Country Gentleman, May 26, 1910, 75:518[36]

A discussion of remedial and preventive measures.

West Indian Cecidomyiidae. Entomological News, 1910, 21:268-70

Cecidomyia manihot on Cassava, Camptoneuromyia meridionalis from flower buds of Ipomoea are described as new. The larva of Schizomyia ipomoeae Felt is also characterized.

Maple Leaf Aphis. Country Gentleman, June 23, 1910, 75:603[14]

A brief general account of Pemphigus tessellata Fitch on maple.

Beet Leaf Miner. Country Gentleman, June 30, 1910, 75:622[25]

A summary economic account of Pegomya vicina Lintn.

Flies in the Stable. Country Gentleman, June 30, 1910, 75:628[11]

A general discussion of the house fly problem, Musca domestica Linn., with special reference to stables and methods of preventing breeding.

Onion Maggot. Country Gentleman, July 7, 1910, 75:642[17]

Remedies for Phorbia ceparum Meign. are briefly discussed.

Apple Tree Borer. Country Gentleman, July 7, 1910, 75:642[37]

Brief discussion of remedial measures for Saperda candida Fabr.

Green Fruit Worm. Country Gentleman, July 7, 1910, 75:646[47]

Records injuries by a green fruit worm, Xylina antennata Walk., in New York State.

Beans Hurt by Maggot. Country Gentleman, July 14, 1910, 75:660[11]

A summary account of Phorbia fusciceps Zett., with special reference to remedial measures.

Flea Beetle. Country Gentleman, July 21, 1910, 75:682[26]

A brief practical account of Epitrix cucumeris Harr.

Corn Worm. Country Gentleman, July 28, 1910, 75:703[13]

Control measures for Heliothis armiger Hubn. are briefly outlined.

Maple Scale. Country Gentleman, July 28, 1910, 75:703[17]

A summary discussion of the cottony maple scale, Pulvinaria vitis Linn., with mention of the woolly Phenacoccus acericola King and the alder and maple plant louse, Pemphigus tessellata Fitch.

Plant Lice. Country Gentleman, August 4, 1910, 75:722[24]

General directions for spraying for plant lice or Aphididae.

25th Report of the State Entomologist on the Injurious and Other Insects of the State of New York, 1909. Education Department Bulletin. N. Y. State Mus. Bul. 141, 1910, p. 1-178, 22 pl. (Issued August 4, 1910)

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Malaria and Mosquitos in New York State. Atti della Societa per gli studi della malaria, vol. 9, 1910, Separate p. 1–12

Summary discussion of malaria in New York, with a brief notice of the malaria-carrying species, their breeding places, enemies and legislation in relation thereto. A brief account is given of the mosquito control work in the State.

The Elm Leaf Beetle. Country Gentleman, Aug. 11, 1910, 75 :740^{25}

A record of injury with a summary discussion of remedial measures for Galerucella luteola Müll.

Recent Observations upon European Insects in America. Economic Entomology Journal, 1910, 3 :340–43

Notes are given on Pissodes notatus Fabr., Dichromeris marginellus Fabr., Hyponomeuta malinella Zell., Saturnia pavonia Linn., Monarthropalpus buxi Lab. and Chermes piceae Ratz., all recently brought into this country.

Gall Midges of Aster, Carya, Quercus and Salix. Economic Entomology Journal, 1910, 3 :347–56

A tabulation of the American species of Cecidomyiidae occurring upon the above named plants — 46 being recorded on willow. A new genus, Asteromyia, is erected and two new species, Oligotrophus salicifolius and Dasyneura corticis, described.

Scientific Notes. Economic Entomology Journal, 1910, 3 :381

Galerucella luteola Müll is recorded from Fort Ticonderoga and serious injuries are reported throughout the Hudson valley. Observations are presented on the work and flight of the snow-white linden moth, Ennomos subsignarius Hübn.

Red Spider. Country Gentleman, Aug. 18, 1910, 75 :762^{36}

A discussion of injuries and remedial measures.

Melon Aphis. Country Gentleman, Aug. 18, 1910, 75:764^{12}

Remedial measures for Aphis gossypii Glov. are given.

Tree Spraying. Country Gentleman, Aug. 25, 1910, 75:789^{15}

Observations on methods employed by "tree-protecting companies" and those of service in controlling elm leaf beetle.

Scale on Maple. Country Gentleman, Aug. 25, 1910, 75:789^{26}

Putnam's scale, Aspidiotus ancylus Putn. is identified and spraying with a lime-sulfur wash advised where the scale is abundant.

Vermin in the House. Country Gentleman, Aug. 25, 1910, 75:800^{21}

The bed bug, Cimex lectularius Linn. is briefly described and exterminative measures fully discussed.

Asparagus Beetles. Country Gentleman, Sept. 8, 1910, 75:840^{24}

Arsenical applications, preferably arsenate of lead, are recommended for the control of both species of asparagus beetles, Criocerus asparagi Linn. and C. duodecimpunctata Linn.

Tulip Scale. Country Gentleman, Sept. 8, 1910, 75:840^{32}

Spraying with contact insecticides in early September to destroy the young of Eulecanium tulipiferae Cook is advised.

Harvest Mites. Country Gentleman, Sept. 8, 1910, 75:840^{37}

The life history of this pest is briefly sketched and methods of avoiding infestation and allaying the irritation following an attack given.

Woolly Aphis. Country Gentleman, Sept. 8, 1910, 75:840^{42}

Remedial measures are given for the woolly aphis, Schizoneura lanigera Hausm. and also for the scurfy scale, Chionaspis furfura Fitch.

Horticulture: Diseases and Pests. New York State Education Department. Review of Legislation, 1907–8. Legislation 391, p. 119–22 (Issued Sept. 1910)

A review of legislation for the years 1907 and 1908.

The Leopard Moth. Country Gentleman, Sept. 29, 1910, 75:922^{21}

This insect, Zeuzera pyrina Fabr. and its work is described and control measures summarized.

ADDITIONS TO COLLECTIONS, OCT. 16, 1909–OCT. 15, 1910

The following is a list of the more important additions to the collections:

DONATION

Hymenoptera

Thalessa atrata Fabr., black long sting, adult on maple, June 13, S. W. Stillwell, Charlotteville

T. lunator Fabr., lunate long sting, adult, July 23, A. L. Kampfer, Albany

Aulacidea tumidus Bass., gall on Lactuca, August 30, Roy Latham, Orient Point

Neuroterus batatus Fitch, galls on white oak, July 8, J. H. Dodge, Rochester. Through State Department of Agriculture

Lophyrus abbotii Leach, Abbott's sawfly, larvae on pine, August 3, Andrew Lackey, Johnsburg. Same, from J. W. Wilson, Olmstedville

L. ? lecontei Fitch, Leconte's pine sawfly, larvae on pine, October 20, Townsend Cox, jr, Setauket

Trichiocampus viminalis Fall., poplar sawfly on poplar, August 29, H. S. Post, Albany

Eriocampoides limacina Retz., cherry and pear slug, larvae on cherry, August 22, L. A. Rose, Rensselaer

Harpiphorus tarsatus Say, sawfly, larvae on Cornus mascula, September 15, J. H. Dodge, Rochester. Through State Department of Agriculture

H. versicolor Nort., sawfly, larvae on Cornus alternifolium, September 18, L. F. Rinkle, Boonville

Coleoptera

Entimus imperialis Forster, diamond beetle, adult, May 7, Richard Lohrmann, Herkimer

Calandra granaria Linn., granary weevil, adults in grain bins, December 27, P. A. Schaefer, Allentown, Pa.

Magdalis ? barbita Say, black elm snout beetle, grubs on elm, March 18, S. L. Frey, Palatine Bridge

Pissodes strobi Peck, white pine weevil, larvae on pine, July 13, Benjamin Dorrance, Dorranceton, Pa. Through Hermann Von Schrenk

Phloeodes diabolicus Lec., adult on Polyporus growing on Eucalyptus, March 20, Hermann Von Schrenk, Southern California

Bruchus obtectus Say, bean weevil, adults, March 21, F. A. Fitch, Randolph

Haltica ignita Ill., strawberry flea beetle, adults on Virginia creeper, August 3, Miss L. E. Clarke, Canandaigua

Galerucella luteola Müll., elm leaf beetle, larvae and pupae on elm, July 19, F. T. Clark, Ticonderoga

Melasoma scripta Fabr., cottonwood leaf beetle on poplar, September 7, Theodore Foulk, Flushing. Through State Department of Agriculture

Centrodera decolorata Harr., adults on locust, October 18, Mrs J. De P. Lynch, Barneveld

Desmocerus palliatus Forst., cloaked knotty horn, adults on elder, June 6, H. T. Brown, Rochester

Elaphidion villosum Fabr., maple and oak twig pruner, work on oak, July 31, W. A. Payne, Bronxville

Prionus laticollis Dru., broad-necked Prionus, adult, July 18, Burton Ellison, Poughkeepsie

Xyloryctes satyrus Fabr., rhinoceros beetle, August 1, D. T. Marshall, Hollis

Euphoria inda Linn., bumble flower beetle, adult, September 6, J. D. Keating, Fort Edward

Cotalpa lanigera Linn., goldsmith beetle, adult, April 15, J. R. Gillett, Kingston

Thanasimus rufipes Brahm, adult, July 29, L. H. Joutel, New York (European)

Podabrus rugosulus Lec., adults, June 16, H. B. Filer, Buffalo

Agriotes mancus Say, wheat wireworm, larvae on oats, May 20, Purley Minturn, Locke

Diptera

Calliphora viridescens Desv., larvae, July 30, Mrs H. G. Reist, Schenectady

Bombyliomyia abrupta Wied., adult, July 26, H. E. A. Dick, Rochester

Rhyphus fenestralis Scop., adults, April 24, G. C. Hodges, New Hartford

Bibio xanthopus Wied., adult, May 18, Richard Lohrmann, Herkimer

Contarinia johnsoni Sling., grape blossom midge, adult, May 28, Fred Johnson, North East, Pa.

Monarthropalpus buxi Lab., pupae on box, May 19, A. E. Stene, Kingston, R. I.

Joanissia aurantiaca Kieff., Aprionus miki Kieff., A. pinicola Kieff. MS., Monardia stirpium Kieff., Bryomyia bergrothi Kieff., Miastor cerasi Kieff. MS., Brachyneura squamigera Winn., Winnertzia fusca Kieff. MS., W. pinicola Kieff. MS., Colomyia clavata Kieff., Colpodia anomala Kieff., Dicerura scirpicola Kieff., Porricondyla venustus Winn., Camptomyia ? binotata Kieff., C. nigricornis Kieff., Holoneurus pilosus Kieff. M.S., Lasioptera rubi Heeg., Baldratia salicorniae Kieff., Stefaniella atriplicis Kieff., Trotteria sarothamni Kieff., Rhizomyia silvicola Kieff., Cystiphora taraxaci Kieff., Macrolabis stellariae Kieff., Arnoldia castanea Kieff. MS., A. sambuci Kieff., A. cerris Koll., Lasiopteryx (Ledomyia) divisa Kieff., L. (Ledomyia) lugens Kieff., Dasyneura sisymbrii Schrnk., D. urticae Perris, Rhabdophaga karschii Kieff., R. pierrei Kieff., Mikiola fagi Hart., Psectrosema tamaricis Stef., Schizomyia galiorum Kieff., Zeuxidiplosis giardiana Kieff., Stenodiplosis geniculati Reut., Thecodiplosis brachyntera Schw., Bremia longipes Kieff., B. ramosa Kieff., Aphidoletes urticariae Kieff., Massalongia rubra Kieff., Hormomyia cornifex Kieff., Monarthropalpus buxi Lab., Pseudhormomyia granifex Kieff., Xylodiplosis aestivalis Kieff., X. nigritarsis Zett., Putoniella marsupialis F. Lw., Endaphis perfidus Kieff., Macrodiplosis volvens Kieff., Clinodiplosis galliperda F. Lw. All from Prof. J. J. Kieffer, Bitsch, Germany, and especially valuable because a number are cotypes

Lepidoptera

Sphecodina abbotii Sm. & Abb., Abbott's sphinx, larva on woodbine, July 13, Mrs Carriere, Albany

Saturnia pavonia Linn., Emperor moth, cocoon on French nursery stock, January 31, Rochester. Through State Department of Agriculture

Anisota senatoria Sm. & Abb., larvae on oak, September 9, L. C. Griffith, Lynbrook. Through State Department of Agriculture

Basilona imperialis Dru., Imperial moth, larva on pine, August 18, Andrew Lackey, Johnsburg

Ctenucha virginica Charp., larvae on pine and gooseberry, L. H. Adams, Johnstown. Through State Department of Agriculture

Halisidota caryae Harr., hickory tussock moth, larvoe on maple, July 11, L. C. Griffith, Lynbrook. Through State Department of Agriculture

Arsilonche albovenosa Goeze, larva, September 27, William Hotaling, Kinderhook

Xylina antennata Walk., green fruit worm, larvae on maple, June 16, Alex Anderson, Stonyford. Same, larvae on apple, June 28, Geneva. Through State Department of Agriculture

Notolophus antiqua Linn., rusty tussock moth, eggs, March 9, H. W. Gordinier, Troy. Same, caterpillars on elm, June 18, H. E. Vaughan, Ogdensburg

Datana ? integerrima G. & R., larvae, July 11, L. C. Griffith, Lynbrook. Through State Department of Agriculture

Schizura concinna Sm. & Abb., red-humped apple caterpillar, larvae on apple, September 10, C. C. Perry, Eagle Bridge

Synchlora viridipallens Hulst, adult, August 4, Louis Capron, Menands

Cingilia catenaria Dru., chain-spotted geometer, larvae on sweet fern, bayberry, August 2, L. C. Griffith, Sag Harbor. Through State Department of Agriculture

Ennomos subsignarius Hübn., snow-white linden moth, eggs on maple, March 28, Edward Thomson, Frost Valley, Denning. Same, adult, July 22, J. C. Ayer, Glen Cove

Phobetron pithecium Sm. & Abb., hag moth caterpillar, larva, September 13, W. A. Bullis, West Sand Lake

Zeuzera pyrina Linn., leopard moth, pupae, July 1, H. I. Newell, Richmond Hill. Same, exuviae on maple, July 5, T. J. Beam, Port Chester. Through State Department of Agriculture. Same, larva on apple, September 17, E. G. Serins, South River, N. J. Through Country Gentleman

Hyponomeuta malinella Zell., ermine moth, larvae on imported French apple stock, June 24, J. H. Dodge, Rochester. Same, larvae on apple, June 27, J. J. Barden, Orleans

Ancylis nubeculana Clem., larvae on apple, September 1, R. H. Ham, Niverville

Dichomeris marginellus Fabr., Juniper webworm, larvae on Juniper, February 28, S. G. Harris, Tarrytown. Same, larvae on Irish Juniper, April 26, L. D. Rhind, Plandome. Through State Department of Agriculture

Aspidisca splendoriferella Clem., resplendent shield bearer, winter cases, March 24, Benjamin Hammond, Fishkill

Hemiptera

Belostoma americanum Leidy, giant waterbug or electric light bug, adult attached to a fish, May 4, J. D. Collins, Utica

Brochymena quadripustulata Fabr., adult, July 15, D. H. Cook, Altamont. Same, nymphs, August 26, W. P. Thorne, Lagrangeville

Blissus leucopterus Say, chinch bug, nymphs on corn, August 5, Fred Wheeler, Mongaup Valley. Through State Department of Agriculture

Haematopinus piliferus Burm., sucking dog louse, adult on dog, January 8, V. P. D. Lee, Altamont

Ormenis pruinosa Say, lightning leaf hopper on matrimony vine, August 26, Mrs C. F. Webber, Athens

Aleyrodes vaporariorum Westw., white fly on coleus, August 26, Mrs C. F. Webber, Athens

Chermes abietis Linn., spruce gall aphis, galls on spruce, June 23, F. F. Briggs, Pocantico Hills. Same, adults on spruce, June 26, S. G. Harris, Tarrytown. Same, galls on spruce, October 12, Theodore Foulk, Flushing

C. cooleyi Gill., galls on Colorado blue spruce, August 4, White Plains, State Department of Agriculture

C. pinicorticis Fitch, pine bark aphid, adults on pine, May 12, M. T. Richardson, New York city. Same, eggs, February 12, Miss Pauline Goldenmark, New York city

C. piceae Ratz., adults and eggs on Nordmann's fir, May 17, Rochester. Through State Department of Agriculture

C. pinifoliae Fitch, pine leaf aphid, adult on black spruce, January 29, Miss Edith M. Patch, Orono, Me.

C. consolidatus Patch, adults on larch, January 29, Miss Edith M. Patch, Orono, Me.

C. floccus Patch, adult on black spruce, January 29, Miss Edith M. Patch, Orono, Me.

C. lariciatus Patch, adults on white spruce, January 29, Miss Edith M. Patch, Orono, Me.

Pemphigus imbricator Fitch, beech blight, nymph on beech, August 31, G. C. Wood, Barneveld

P. tessellata Fitch, woolly maple leaf aphid, adults on maple, June 16, A. P. Knapp, Hillsdale, N. J. Through Country Gentleman. Same, eggs, June 20, Miss May Seymour, Lake Placid

Schizoneura americana Riley, woolly elm leaf aphid, adults on elm, June 5, R. M. Boren, Ballston Lake. Same, adults and young on elm, June 10, W. P. Judson, Broadalbin. Same, adults on elm, June 18, H. E. Vaughan, Ogdensburg

S. lanigera Hausm., woolly apple aphis, nymph on apple, November 9, C. S. Ashley, Old Chatham. Same, Mrs S. H. Niles, Coeymans. Same, November 10, J. F. Rose, South Byron. Same, November 13, Bell & Smith, Castleton. Same, C. C. Woolworth, Castleton

Lachnus abietis Fitch, on balsam, September 8, C. H. Peck, Lake Placid

Psylla pyricola Forst., pear psylla, adults on pear, September 20, John Dunbar, Rochester

Pachypsylla celtidis-gemma Riley, hackberry nodule gall, galls on hackberry, February 16, H. B. Smith, Nashville, Tenn. Through Garden Magazine, Doubleday, Page & Co.

Eulecanium tulipiferae Cook, tulip tree scale on tulip, August 31, O. W. Peterson, Fairfield county, Conn. Through Country Gentleman

Asterolecanium pustulans Ckll., golden oak scale, adults on oak, May 16. Through State Department of Agriculture

A. variolosum Ratz., on oak, September 7, Theodore Foulk, Flushing. Through State Department of Agriculture

Phenacoccus acericola King, false cottony maple scale, young, January 21, Archibald Beresford, Mt Vernon. Same, eggs on maple, July 18, Mrs Alice G. Fisher, Batavia. Same, females and young on maple, October 4, Miss Fanny G. Dudley, Newburgh

Pseudococcus longispinus Targ., mealy bug, February 24, C. E. Olsen, Winfield. Same, larvae on coleus, August 30, Albany. Through Country Gentleman

Pulvinaria vitis Linn., cottony maple scale, females and young on maple, July 26, G. W. Morley, Haverstraw. Through State Department of Agriculture

P. occidentalis subalpina Ckll., immature, August 31, T. D. A. Cockerell, Boulder, Col.

Gossyparia spuria Mod., elm bark louse on elm, July 9, R. H. C. Bard, Syracuse. Through State Department of Agriculture

Eriococcus azaliae Comst., on azalea, November, Brooklyn. Through State Department of Agriculture

Aulacaspis pentagona Targ., West Indian peach scale, adult on imported Japanese flowering cherry, January, P. L. Huested, Kingston. Same, adult on Japanese cherries, February 3. Through State Department of Agriculture

A. rosae Bouché, rose scale on rose, November 13, C. C. Woolworth, Castleton. Same, adults on rose, April 29, L. L. Woodford, Pompey

Chionaspis americana John., elm scurfy scale, crawling young, May 10, W. B. Landreth, Schenectady

C. euonymi Comst., euonymus scale, eggs on ? Euonymus, May 19, C. H. Hechler, Roslyn

Fiorinia fioriniae var. japonica Kuw., adults on Japanese hemlock, June 9, Long Island. Through State Department of Agriculture

Orthoptera

Chortophaga viridifasciata DeG., green-striped grasshopper, nymphs, March 26, N. Ashley, Old Chatham

EXCHANGE

Galls received from Prof. Mario Bezzi, Torino, Italy

Cystiphora sonchi F. Lw. on Sonchus arvensis L., Sondrio, Italy
Dryomyia circinans Gir. on Quercus cerris L., Mantua, Italy
Dryomyia lichtensteinii F. Lw. on Quercus ilex, Macerata, Italy
Dasyneura sisymbrii Shrnk. on Nasturtium silvestris L., Milan, Italy
[1] Perrisia sp. on Cucubalus bacerifer (?) L., Bergamo, Italy
Perrisia sp. on Polygonum bistorta L., Sondrio, Italy
Perrisia alpina F. Lw. on Silene acaulis L., Sondrio, Italy
Perrisia capitigena Br. on Euphorbia cyparissias L., Macerata, Italy
Perrisia crataegi Winn. on Crataegus oxyacantha L., Milan, Italy
Perrisia ericina F. Lw. on Erica carnea L., Como, Italy
Perrisia fraxini Kieff. on Fraxinus excelsior L., Sondrio, Italy

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[1] A synonym of Dasyneura.

Perrisia oenophila Haimh. on Vitis vinifera L., Sondrio, Italy
Perrisia pustulans Rubs. on Spiraea ulmaria L., Sondrio, Italy
Perrisia rosarum Hdy. on Rosa canina L., Sondrio, Italy
Perrisia salicariae Kieff. on Lythrum salicaria L., Milan, Italy
Perrisia ulmariae Br. on Spiraea ulmaria L., Sondrio, Italy
Rhabdophaga rosaria H. Lw. on Salix purpurea L., Sondrio, Italy
Mikiola fagi Hart. on Fagus silvatica L., Bergamo, Italy
Rhopalomyia artemisiae Bouché on Artemisia campestris L., Sondrio, Italy
Oligotrophus sp. on Juniperus communis L., Mallare, Italy
Oligotrophus capreae Winn. on Salix caprea L., Sondrio, Italy
Oligotrophus corni Gir. on Cornus sanguinea L., Relegon, Como, Italy
Oligotrophus reaumurianus F. Lw. on Tilia parviflora Clerk., Sondrio, Italy
Oligotrophus solmsii Kieff. on Viburnum lantana L., Sondrio, Italy
Oligotrophus taxi Inchb. on Taxus baccata L., Mallare, Italy
Mayetiola poae Bosc. on Poa nemoralis L., Sondrio, Italy
Asphondylia sp. on Scrophularia canina L., Selvius, Bergamo, Italy
Asphondylia sarothamni H. Lw. on Sarothamnus scoparius Link., Sondrio, Italy
Schizomyia pimpinellae F. Lw. on Pimpinella magnus L., Como, Italy
Harmandia petioli Kieff. on Populus tremula L., Sondrio, Italy
Harmandia tremulae Winn. on Populus tremula L., Sondrio, Italy
Clinodiplosis vaccinii Kieff. on Vaccinium uliginosum L., ? Valmaleneo, Sondrio, Italy

APPENDIX

MIASTOR AMERICANA FELT

An account of pedogenesis

The remarkable larvae of Miastor, presumably M. americana Felt, were found Oct. 5, 1910 under the partially decayed inner bark and in the sapwood of a chestnut rail used to fence a shady roadside in the vicinity of Highland. Additional material was secured October 19th, and from these two lots we have been fortunate in being able to follow through the larval life cycle and to actually witness pedogenesis, now regarded as a modification of parthenogenesis. These minute larvae are very easily handled and studied and should therefore be extremely serviceable to teachers of zoology and biology desiring to give their classes first-hand information respecting this phase of reproduction. Our studies of this form are given below in some detail in the hope that many teachers will find it advantageous to make use of these larvae in their class work.

Habitat. The moist inner bark of various trees showing incipient decay is the most likely place to find Miastor larvae. Those discussed in these pages were discovered in the fall, working in the partially decayed chestnut bark of a rail fence along a shaded roadside. The larvae were most abundant in the soft, partly decayed bast just beyond the point invaded by various borers in dead wood and the accompanying predaceous Dipterous larvae. An allied, though undetermined, species was taken under similar bark of a chestnut stump in a wood lot. European observers report the occurrence of these and allied larvae under the bark of a variety of trees, such as beech, birch, poplar, oak, elm, ash and ironwood, and even in sugar beet residue.

Recognition characters. It is very probable that these larvae have been repeatedly overlooked by collectors, simply because when occurring singly or in small colonies they present no very striking characteristics. Large colonies of this remarkable form are easily recognized by the masses of more or less adherent yellowish or whitish larvae, and especially by the presence here and there of larger, motionless individuals, some of which usually contain young so well developed as to be easily seen with a hand magnifier. A careful examination with a pocket lens will show, even in the case of isolated larvae, a distinct head and a fuscous ocular spot in the sedgment just behind. The head is flattened, triangular, with a pair of diverging antennae and quite different from the strongly convex, usually fuscous head of Sciara larvae sometimes occurring in similar situations. Predaceous larvae likely to be associated with Miastor, may be instantly recognized by the body tapering to the small anterior segments, and especially by the chitinized, usually fuscous, hooked mouth-parts. Small Dipterous maggots having a length of one-twentieth to one-eighth of an inch and occurring under conditions described above, should be carefully examined if one is searching for this or allied species.

Value to zoologists and biologists. Miastor larvae and their allies should be of great service to teachers of zoology and biology, since they admit of the study at first-hand of one form of parthenogenesis. It is possible with a no more elaborate outfit than an ordinary student's microscope equipped with a three-quarter objective, a microscopic slide and a few cover glasses, to observe the vital activities of the young larva, to see the muscular, respiratory, digestive and nervous systems, to identify the ovaries and to watch the gradual development of the semitransparent embryos within the mother larva. Furthermore, this larva is well adapted to more exact histological methods, being soft and therefore an excellent subject for serial sections and stains, particularly as it is comparatively easy to secure from one colony a series of individuals representing different stages of development.

There are other considerations aside from the interest attaching to their morphology and biology which should appeal strongly to the teacher of zoology. These larvae are widely distributed and, with an understanding of their habits, there should be little difficulty in finding them. Moreover, they are small, and a piece of wood six inches long, three inches wide and half an inch thick may contain or produce material enough for a fair sized section or class in zoology. The larvae are prolific and under favorable conditions would probably multiply at any season of the year. This is certainly true of the fall, the early winter and the spring. They are so amenable to artificial conditions as to make it possible to keep them alive for at least a month in microscopic cells, and with care a larval generation will develop in such restricted quarters. We have kept larvae healthy and multiplying for more than three months with nothing more elaborate than a moist piece of decaying wood clamped lightly to an ordinary microscopic slide. These remarkable larvae are very hardy. Prolonged dryness simply results in a suspension of activities, while they are quite resistant to an abundance of moisture. We have kept them alive in sealed water-filled cells without food for five weeks. With our present knowledge we see no reason why artificial colonies might not be established in the vicinity of a zoological laboratory and maintained with very little or no attention from year to year, if not for a decade or more.

Description. The parents of these remarkable larvae are small midges belonging to the Dipterous family Itonidae, better known as the Cecidomyiidae or gall midges. The members of this family are all small Diptera with the tibiae unarmed apically, the coxae not produced and the wings usually with but three or four long veins and no cross veins. Extreme forms may have six or seven long veins and one cross vein or, as a result of reduction, the veins may have nearly disappeared.

The subfamily Heteropezinae, to which Miastor and its allies belong, comprises a number of exceedingly peculiar forms, some of them most remarkable on account of the great degree of specialization by reduction — physiological as well as morphological. Members of this subfamily may be separated from the Itonidinae by the absence of circumfili, and from the Lestremiinae by the great reduction in the venation, there being at most, three long veins. The metatarsus may be longer than the following segment, while the number of tarsal segments may be reduced to two. Certain species have quinquearticulate tarsi and the wing membrane thickly clothed with rather broad, striate scales. The production of larvae by larvae or pedogenesis is known to be true of several genera referable to this subfamily, the larvae of which appear to live for the most part in decaying vegetable matter and are therefore likely to be found in searching for Miastor larvae. The adults of Miastor appear in June, while the one known American species of Oligarces was taken in July. The following table will facilitate the recognition of the genera in this group.

KEY TO GENERA

- *a* Metatarsus longer than the second segment
  - *b* Tarsi quadriarticulate; 3 long veins; palpi biarticulate Miastor Mein.
  - *bb* Tarsi triarticulate; 2 long veins; antennal segments cylindric Heteropeza Winn.
- *aa* Metatarsus shorter than the second segment
  - *b* Tarsi quinquearticulate
    - *c* Wing membrane finely haired
      - *d* 3d vein extending to the apex of the wing
        - *e* Palpi quadriarticulate
          - *f* 5th vein forked Haplusia Karsch
          - *ff* 5th vein simple Johnsonomyia Felt

ee Palpi triarticulate Meinertomyia Felt
dd 3d vein not extending to the apex of the wing
eee Palpi uniarticulate Leptosyna Kieff.
e Palpi biarticulate Frirenia Kieff.
ee Palpi triarticulate Epimyia Felt
cc Wing membrane scaled; 3 simple veins; palpi triarticulate Brachyneura Rond.
bb Tarsi biarticulate Oligarces Mein.

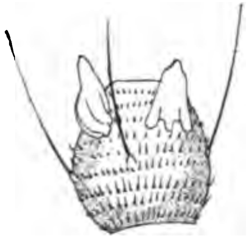

Fig. 7 Fifth antennal segment of Miastor americana, greatly enlarged. (Original)

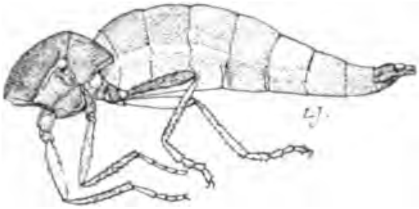

Fig. 10 Side view of thorax, legs and abdomen of Miastor americana. (Original)

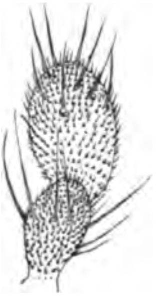

Fig. 8 Palpus of Miastor americana, greatly enlarged. (Original)

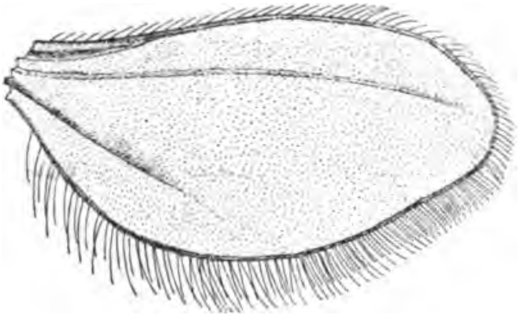

Fig. 9 Wing of Miastor americana, greatly enlarged. (Original)

M. americana. *Female.* Length 2.5 mm., slender. Antennae extending to the base of the coxae, sparsely haired, brown; 11 segments, the first short, stout, irregularly subglobose, the second ½ longer, the fifth subcylindric, with a length about ¼ greater than its diameter, tapering at both extremities, subsessile; a very sparse subbasal whorl of stout setae; subapically and apparently on the ventral surface, a pair of large, irregularly subconic, semitransparent processes (fig. 7); the distal segment subglobose, broadly rounded apically. Palpi biarticulate, the first segment irregularly oval, the second ½ longer, broadly oval, both sparsely setose. Mesonotum dark brown. Scutellum reddish brown, postscutellum fuscous yellowish. Abdomen pale salmon, fuscous basally, yellowish apically. Wings hyaline, costa pale yellowish, subcosta uniting with the margin at the basal third, the third vein, curving distally, just before the apex, the fifth simple and disappearing just before the basal half; fringe long, slender. Legs a nearly uniform yellowish brown, the tarsi quadriarticulate, the first segment short, about ½ longer than the second, which latter is distinctly longer than the third, the fourth a little longer and stouter than the second; claws long, slender, simple, the pulvilli nearly as long as the claws. Ovipositor short, the lobes long, slender, triarticulate, the basal segment stout, subtriangular, the second longer, subrectangular, the third narrowly oval, all sparsely setose; on the venter of the seventh abdominal segment there is a submedian pair of obpyriform, chitinous appendages, possibly orifices of odoriferous glands.

Larva (presumably M. americana). Length 1.25 to 4 mm. Young larvae yellowish or whitish transparent, the larger larvae whitish or reddish orange. The large, white larva is rather stout, tapering somewhat at both extremities and frequently nearly filled with white adipose tissue. There are 13 body segments. The head (pl. 26, fig. 2) is small, triangular and frequently retracted within the body segments. The palpi are short, stout, biarticulate and arising from the anterior portion of the head, the tip of the head usually fuscous. The irregularly bilobed ocular spot is usually seen as a fuscous mass in the third segment. The posterior extremity tapers to an obtuse apex bearing a series of 6 stout, frequently recurved, cuticular processes. The body segments are banded ventrally (pl. 29, fig. 2) with closely set series of short, stout spines pointing backward, these spines being most strongly developed upon the anterior body segments, especially the third, fourth and fifth (pl. 22).

The quiescent larva, easily recognized by its somewhat stiff attitude, due probably to the relaxation of the transverse muscles girdling each segment, may be whitish and contain semitransparent embryos, easily seen by reflected light (pl. 23, fig. 1) or yellowish and filled with nearly mature embryos (pl. 24, fig. 1).

The young larvae are 1.2 to 2 mm. long and present all the characters described above for the larger white larvae except that they are yellowish or yellowish transparent, usually more slender and appear to have a relatively much better developed musculature.

Musculature. The muscles are especially well developed in the young larvae. They consist of a series of longitudinal and oblique muscles extending from the anterior to the posterior margins of the body segments. There are a number of transverse, girdling muscular bands, which are particularly well developed at the union of the body segments, though several distinct broad bands may be observed near the middle of each segment.

Respiratory system. The tracheal trunks comprise a double series on each side extending nearly the entire length of the body and sending minute branches to lateral spiracles on the fourth to the eleventh body segments. The dorsal trunks are united to each other by transverse tracheae in the posterior third of body segments five to eleven inclusive and, in addition, send minute branches to the various organs of the body. The tracheal system of a living, semitransparent larva may be easily examined in a water mount.

Nervous system. This is composed of the pyriform submedian optic lobes and the fuscous, lobulate, socalled ocular spot, the bilobed brain in the fourth and fifth body segments and a series of ganglia united by submedian nerves as follows: A broadly oval ganglion occupying the length of the third body segment and with a width fully equal to half its diameter; a shorter, more slender ganglion in the anterior portion of the fourth segment; a broadly pyriform ganglion in the anterior third of the fifth body segment. Separated slightly therefrom, another ganglion lies in the posterior portion of the fifth and the anterior part of the sixth body segments. It is a little narrower than the preceding though it has an equal length. The fifth and sixth ganglia, each short, subquadrate, occur in the sixth body segment; the seventh ganglion is one-half longer than the sixth and is situated in the middle of the seventh body segment; the eighth to the twelfth body segments each appear to have one ganglion, the posterior one almost extending to the anterior margin of the thirteenth body segment.

Digestive system. The digestive system, difficult to study because of its being largely inclosed by nearly opaque adipose tissue, consists, according to Kahle, of a comparatively simple tube extending the entire length of the body, the granular salivary glands occurring in the fifth to the ninth body segments, while the long, slender, malpighian tubes may be found in the 11th to 13th segments, inclusive.

History of pedogenesis. The discovery of this remarkable phenomenon is credited to Nicolas Wagner, professor of zoology at Kasan. He published a short note in the *Journal of the University of Kasan* in 1861 or 1862, and in 1865 a detailed account. The latter was held by the editor for almost two years because of its "almost increditable" character. The observations of Wagner were confirmed by Meinert and Pagenstecher in 1864, and by Hanin, Leuckart and Mecznikoff in 1865. Wagner believed at first that the embryos originated in the adipose tissue, at the expense of which they develop very largely. Later he, Leuckart and Mecznikoff satisfied themselves that the embryos originated from ovaries.

The investigations of these scientists covered approximately a decade, 1862 to 1872, which was followed by a long period of apparent lack of interest in these larvae, very little original being published from the latter date until the exhaustive studies in 1908 by Kahle, who employed modern laboratory methods, demonstrated the general correctness of the earlier observations and satisfied himself that the process was a true parthenogenesis. It does not seem to have occurred to any one that these larvae might be of great service to the teacher of biology.

This method of reproduction has been observed by Meinert in Miastor, Oligarces and Meinertomyia (Pero Mein.) and by Kieffer in Leptosyna. The latter believes the same to be true of Frirenia, though he has not observed mother larvae, since the females contain the unusually large eggs characteristic of genera reproducing in this manner.

Pedogenesis or close approach thereto is known to occur in the Chironomidae. Grimm in 1870 describes a larval Chironomus in which eggs develop, they escaping, however, from paired submedian ventral orifices in the eighth abdominal segment of the pupa. This must be construed as at least a modification of the process exhibited by Miastor and its allies. Professor Johannsen recorded in 1910 a pedogenetic larva, Tanytarsus dissimilis Jhns., which had come under his observation and that of the late Dr James Fletcher, though no data has been published to show the exact character of this process. Professor Johannsen also refers to an account of pedogenesis in this genus observed in Bohemia by Professor Zavrel.

Habits. These larvae appear to thrive only in the moist, partly rotten inner bark and punky sapwood which has not been invaded to any considerable extent by other Dipterous larvae or Coleopterous borers. They exhibit a manifest tendency to occur in segregated masses, frequently between loose flakes of bark or in rather broad crevices. These colonies contain in autumn old empty skins of mother larvae; a number of yellowish mother larvae with approximately five to fifteen young within; very numerous, small, yellowish larvae showing no trace of embryos; a number of white, various sized active larvae, frequently white, sometimes semitransparent; and a few quiescent white larvae containing young embryos. Such larval colonies are most likely to be found in somewhat flaky inner bark, especially where conditions allow several larvae to lie side by side (pl. 26, fig. 1).

Slender, yellowish larvae are often found lying between wood fibers, in some instances apparently having penetrated several inches from the nearest adjacent larvae. These latter do not appear to grow so rapidly as is the case in the more populous colonies, and they also seem to be less prolific, since the few larvae we have observed under such conditions, produced only three or four, and mostly but one, young. The small, yellowish larvae lying in crevices, mentioned above, frequently occur in series, sometimes one or two lying side by side. They move comparatively little, action being confined largely to the head and the semitransparent anterior body segments. Such larvae appear to remain almost unchanged for two weeks or more. These muscular larvae, with their bands of retrose spines especially well developed on the anterior body segments, are admirably adapted for forcing their way between partially rotten tissues, a procedure which is also of material service in giving them relative immunity from attack by natural enemies. The small yellow larvae were most abundant in our material during the winter months.

Active larvae crawl rapidly over moist wood and glass, and have even been observed wriggling between colonies of mold. Lack of moisture appears to cause a partial suspension of vital activities, while flooding does not seem to be very injurious. The mouthparts of the larvae, though the anterior portion of the head is strongly chitinized, appear to be comparatively weak, and, while we have repeatedly observed these larvae moving the head about and examining adjacent tissues, we have seen no indication of gnawing or boring. The alimentary canal contains little that can be discerned with the aid of a compound misroscope, and we are inclined to believe that a considerable portion of their nourishment is absorbed by osmosis after escaping from the mother larva, as well as before. It would appear as though the several types of larvae occurring in a colony are possibly only modifications, due to the relative amount of nourishment obtained by the individual.

Normally, reproduction by pedogenesis occurs throughout the warm months of the year and even into late fall, and commences in early spring, the cold weather of winter simply causing a suspension of activities. Dr Kahle, after an extended series of observations, was led to believe that asexual multiplication might continue uninterruptedly for possibly a period of two or three years. This appears reasonable, since somewhat recent experiments by Slingerland have shown that a plant louse might produce nearly 100 asexual generations in almost four years and presumably was capable of continuing this much longer. The adults of Miastor and Oligarces occur in midsummer, a season when the midges of most of these forms are probably abroad.

Biological observations. The first larvae secured were taken October 5, 1910, placed in an ordinary fruit jar with moist sand and subsequently allowed to become rather dry. A second lot was obtained October 19 and on examining the latter November 18th, an adherent mass of young larvae evidently recently escaped from the mother larva was found. Soft, partially rotten wood was taken from the earlier lot presumed to contain little or nothing alive, and one or two of these young larvae placed in a groove in each piece of wood, the latter being attached by light clamps, either directly to a microscopic slide or held between a pair. These preparations were kept in a closed tin box on damp blotting paper. It was hoped that we would be able to watch the development of the one or more larvae thus placed in each piece of wood. Most of these for some reason or other escaped and we soon found that the additional moisture given these pieces resulted in renewed activities on the part of many larvae concealed in the woody tissues. On November 28, ten days after these preparations had been made, numerous young larvae were observed in most of the preparations, the majority probably recent young of larvae stirred to renewed activity by the addition of moisture. Throughout November and in early December large, white mother larvae capable of producing from five to perhaps fifteen embryos were frequently seen. The latter part of December and during January large, white larvae were difficult to find and the major portion of the reproduction was by the small, yellow mother larvae usually occurring in crevices in the sapwood and producing only one or two young. These preparations afford an excellent opportunity for determining the duration of the quiescent period under nearly natural conditions. This was found, as a result of observations upon a number of larvae, to be in the vicinity of a week, the movements of the embryo with the fuscous ocular spot and brown anterior portion of the head being observable about five days prior to the escape of the young. The occurrence of a small amount of mold did not seem to have a material effect upon the health of the larvae, and the same was true respecting the presence of mites, Tyroglyphus, which were upon occasions rather abundant in some of the preparations. The larvae crawl readily between the glass and the wood, occasionally making their way to the margin of the preparation and sometimes escaping. A few were found lying upon the damp blotters in the bottom of the box, others between the blotters and more under the lower blotter on the tin bottom of the box. The larvae are evidently able to remain active for considerable periods without nourishment and with comparatively little oxygen, since it was observed that flooding of the preparation, even though continued for two or three days, apparently had no ill effect upon the larvae — subsequently we found that larvae would live submerged several weeks and the embryos develop.

The above was continued by isolating one or more larvae on ordinary microscopic slides. Each of these contained several small slivers of wood approximately .2 mm. thick and 1 to 1.5 em. long. These were laid upon the slide, moistened, several larvae added and a square cover glass placed over the whole, the margins being more or less perfectly sealed with vaseline. These preparations were designed primarily to secure more accurate data as to the length of the quiescent period, to facilitate observation upon the development of the embryo and also to ascertain the feasibility of rearing the larvae under such conditions. It was soon noted that while the vital processes were not at once inhibited by submersion, they were greatly retarded and if flooding was long continued, the embryos were unable to escape from the mother larva, though apparently well developed.

One moderate sized, apparently quiescent larva with finely granular contents and a brownish discoloration on one side was placed in such a cell December 12, 1910, together with a moderate sized, yellowish or yellowish white larva and a number of smaller ones. The 16th it was evident that the adipose tissue of this large larva was disintegrating, the several embryos being about one-half the length of the mother larva. On the 22d the embryo was apparently about three-fourths the length of the mother larva and there were no signs of either head or ocular spot. The next day the developing ocular spot was seen as a pair of narrowly oval, fuscous, submedian bodies, while most of the posterior part of the larva was filled with large, cuboidal cells arranged in a series of columns. The embryo at this time extended from the fifth to the thirteenth body segments of the mother larva. The following day the ocular spot was more evident and the apex of the head discernible. The 27th we were able to recognize two embryos, both with the large cells as described above. The 30th there was a distinct bulging of the mother larva in the region of the fifth body segment, a condition presaging the nearly developed embryo. The next day the ocular spot was black. Observations were continued daily from January 1st to the 13th, during which time development appeared to be slow and a clear definition of the changes undergone almost impossible because of the condition of the cell. January 16th the embryos had escaped.

The moderate sized, yellowish or whitish larva mentioned above was lost sight of for a time, not being located till December 23, 1910, at which time it was found well established on the underside of a splinter of wood and with a length of about 3 mm. It remained moderately active for a time, two embryos being observed the 26th, at which time its color approximated closely that of the wood and accounted in large measure for its being overlooked earlier. The 28th the adipose tissue of the mother larva had nearly disappeared and on the 31st an ocular spot was visible in the young. January 1st the head and ocular spot of two embryos were recognized, and on the 5th embryonic movements were observed. The next day one embryo had extruded its head through the skin of the mother larva. Our records show that embryos remained within this mother larva till the 20th, possibly one or more perishing.

There were at least three small, yellowish larvae placed in this preparation with the two larger ones discussed above. These remained active for some days, two being located as quiescent, each containing an embryo about half the length of the mother larva, December 23, 1910, and from this on were subjected to daily observation. The first of these showed a grouping of the cells in rows the 24th, which became more distinct the next day, and on the 26th a median tract of darker cells was observable. The 28th the embryo extended from the second to the eleventh body segments of the mother larva and showed rather distinct masses of adipose and mesodermal tissue (pl. 35, fig. 3). The ocular spot was evident and the head slightly fuscous. On the 30th movements of the anterior extremity of the embryo and streaming of the body contents were observed, the mesodermal tissue was less conspicuous and the adipose tissue occupied more space. The embryo escaped from the mother larva January 1st. This was unusually early and may have been hastened by artificial causes.

The second small, yellowish, quiescent larva was located December 23, 1910 at which time it contained a large-celled embryo with a length fully one-half that of the mother larva. Three days later the embryo extended from the fifth to the thirteenth segments of the mother lavra, the cells being arranged in indistinct rows and larger at the extremities. Owing to its position, it was impossible to properly illuminate this mother larva. The ocular spot and fuscous head were observed on the 30th and an active, well-developed larva seen January 2d, which remained within the skin of the mother larva till the 12th, an unusually long period, due possibly to the mother larva being partially surrounded by vaseline and therefore deprived of a proper supply of oxygen.

Three months after the establishment of the cell containing the larvae discussed above, their progeny were living under substantially the same conditions and gave every indication of producing young in due time.

A large, white, active larva was isolated under another slide December 12, 1910 with the conditions practically as outlined above. Six days later this larva had worked itself to the margin and become practically inclosed in a vaseline, water-filled cell where it remained for over a month, namely till January 20th. The development was unusually slow, probably due in large measure to the deficient supply of oxygen. Young, oval embryos were observed in the region of the sixth and seventh body segments December 19. On the 24th several embryos were found on the venter in the region of the tenth or eleventh segments, each with a length nearly equal that of the body diameter. There was a gradual increase in length and on the 26th one extended from the eleventh to the fourteenth segments of the mother larva. The adipose tissue was yellowish and reticulate by the 29th, though no signs of ocular spot or mouth parts were to be seen. January 2d a slight row of cells was visible in one embryo, this median streak becoming more apparent on the 5th. Extended masses of large, cuboidal cells were observed on the 7th, the ocular spot showing as a pair of minute, brownish spots. On the 16th well formed, embryonic heads and brown ocular spots were visible. This appeared to be about as far as development could go without additional oxygen, and though the vaseline cell was ruptured on the 20th no larvae escaped. The record is interesting since it gives an idea of the vitality of these larvae under adverse conditions.

Another quiescent, white larva containing at least two embryos was isolated December 12, 1910. The adipose tissue was granular and irregular. On the 16th the larva was nearly filled with whitish transparent embryos, the latter with a distinct median streak. Five days later one embryo had a length equal to one-half that of the mother larva, the embryonic adipose and mesodermal tissue were rather distinct, while the adipose tissue of the mother larva was largely absorbed. On the 22d the form of the mother larva was distinctly modified by the obliquely-lying young, each with a length approximately three-fourths that of the parent. The next day we observed the mesoderm, composed of irregularly arranged, subhexagonal cells, accompanied by the appearance of incipient ocular spots in various embryos. The tip of the head became fuscous by the 28th and on January 5th, slight movements of the embryos were observed. Owing to the reduced oxygen supply, due to the larva being in a practically sealed cell, the embryos experienced difficulty in escaping. One was observed January 9th with the seven anterior segments protruding from the posterior extremity of the mother larva, remaining in the same position and nearly motionless the three following days. The cell was opened January 14th and the mother larva given air, but the action was apparently too late, as the young failed to revive. There appears to be sufficient oxygen in the tissue of the mother larva to permit the embryos to become fully developed.

Methods. The material taken in October was kept in ordinary fruit jars for a time, some of these at least being allowed to become rather dried. There was very little or no multiplication. On November 18th small pieces or slivers of somewhat dried wood containing these larvae were either clamped directly to ordinary microscopic slides or laid between two held together by means of light wire clips. These portions of infested wood were kept on moistened blotting paper in a dark, tin box, being examined every two or three days. Large, white mother larvae were produced from time to time and occasionally considerable colonies of small young were observed in the vicinity of the empty skins of mother larvae. Such preparations enabled us to keep track, not only of a colony but, by noting the location of quiescent larvae, even of individuals. Later this series was supplemented by a few fragments of wood laid upon microscopic slides, covered with large, square cover glasses and the margins more or less perfectly sealed with vaseline. The cell thus formed was kept moist and sometimes flooded with water. Under such conditions full grown white larvae, quiescent larvae and small, white or yellowish larvae were also studied. They apparently thrived for one week at least. Finally we selected a series of small, yellowish, active and quiescent larvae, placed them in water cells and observed the embryos and their various stages of development, photomicrographs being successfully made from this living material.

The observations on the small lots of material noted above were checked by examinations of the fruit jars containing larger amounts of material. The latter jars were especially useful because the very numerous maggots made it possible to select at one time practically all stages, which were mounted in considerable abundance. Some of the larvae were cleared with potassium hydrate and then stained with Fuchsin, Hematoxylin, Eosin and Eosin-Hematoxylin. The actions of the stains were all somewhat unsatisfactory and the majority of our most successful mounts were entire larvae in ordinary balsam preparations which had been thoroughly cleared. The study of the mounts was checked by examination of living material as detailed above.

Embryology. The development of the embryo may be observed in the living larva. It is easily seen in the larger, white individuals common in the fall and producing a number of young, though the changes in the embryo are best observed in the small, yellow larvae, especially if they are mounted in shallow water cells.[1]

The region of the ovaries is marked in the large, white larvae by an irregular, yellowish green streak in the tenth or eleventh segments. A close examination of such a larva may disclose the oval, large-celled ovaries nearly concealed by the submedian masses of opaque, white adipose tissue, especially if the larva rolls slightly. These organs are more easily detected in the young yellowish larva. They are submedian, whitish transparent, contrast rather strongly with the darker, more refractive adipose tissue and are located in the posterior portion of the tenth or the anterior part of the eleventh segment, one frequently being somewhat in advance of the other. They are composed of globular or oval, nucleated cells.

The youngest embryos we have observed are oval, granular and may be found in the large, white larvae in the vicinity of the ovaries. The motion of the internal organs appears to distribute the embryos through the body, there being from one to as many as seventeen in individual mother larvae. The young embryos are semitransparent and present a strong contrast to the opaque adipose tissue of the large, white larvae or the denser cells of the small, yellowish larvae. The youngest embryo photographed is

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[1] We have used a ring of vaseline to support the cover glass and found such a cell very satisfactory as well as economical.

represented on plate 30, figures 2 and 3. It occurred in a small, yellow larva and had a length nearly equal to that of the ninth segment of the mother larva, its width being about one-fourth the diameter of the parent. This embryo is evidently in the morula stage, it being composed of a rather indistinct mass of irregular, closely placed cells, apparently with a slight infolding, the beginning of the blastoderm. At the posterior extremity there is a group of nucleated, large, polar cells. The next stage observed, though not photographed, was seen in larva Y. This embryo had a length equal to nearly twice the diameter of the mother larva. It was narrowly elliptical, with a length approximately three times its diameter and the polar cells, though visible, were not so evident as in the embryo described above. At its anterior extremity there was a slight thickening, apparently the much reduced cells of the corpus luteum. The median portion was occupied by a rather broad streak of dark, granular cells, bordered on either side and at the extremities by lighter, small-celled tissue. A more advanced stage is shown on plate 30, figure 1, and plate 31. This represents an embryo dissected from the large, white type of mother larva. It shows a distinct darker ectoderm and a lighter mesoderm, the anterior extremity having a conspicuous cap of large, dark cells. Portions of the posterior extremity and of the middle of the same embryo are represented still more enlarged on plate 31, figures 1 and 2. The time required for the small embryos to migrate from the region of the ovaries and develop to such an extent as described above and thus produce a quiescent stage in the large, white type of mother larva is approximately four to five days, much appearing to depend upon the size of the mother larva and the number of embryos present. The latter are perhaps most easily seen when viewed by reflected light (pl. 23 fig. 1, 2). The next stage in the development is illustrated on plate 32, figure 1. The embryo has a distinct cephalic cap of dark-celled tissue, a well defined germinal streak, the latter being broadly produced to one side in the region of the anterior third. The same general condition, though in a more advanced stage and apparently from a somewhat different viewpoint, is illustrated on plate 32, figure 4, and plate 33, figure 2, the dark ectoderm occupying one-third the width of the embryo and extending from approximately the region of the sixth to the twelfth segments; the cephalic cap persists as before. This condition appears to be followed shortly, though we have observed it somewhat clearly only in embryos developing in the large, white mother larvae, by a great increase in the ectoderm, accompanied by its folding and extension anteriorly around the posterior extremity, the development of the large lobes anteriorly and its segregation into somatic masses, indistinctly shown on plate 27, figure 2, and apparently producing a peculiar cuboidal aspect illustrated on plate 28. The greatly developed mesoderm includes a series of large, cuboidal cells, some at least probably being the polar cells, and a certain portion destined to develop into a much more conspicuous mass to be described later. These changes are accompanied by a shrinking of the embryo from the extremities of the amniotic sac and the development of the digestive system by an invagination from both extremities. This latter is indicated in living embryos of young yellowish larvae, by the formation of irregular lobes at each extremity and the appearance in the region of the sixth to the twelfth segments, of a considerable mass of large-celled tissue, occupying most of that portion of the body cavity and which we believe to be mesoderm (pl. 35, fig. 2) and identical with that mentioned above. The changes from now on are rapid. This conspicuous mass of mesoderm gradually becomes absorbed or reorganized into organs such as the digestive system, its appendages and especially the ovaries, while the developing adipose tissue expands, occupies more space and produces a three-rowed appearance in the embryo (pl. 35, fig. 3). Development of the head now proceeds, the mouth parts become more definite, the ocular spot visible and the lobes at the posterior extremity become well defined. Motion may be observed in the embryo and shortly it is ready to escape from the mother larva. The length of the fully developed embryo is about 1 mm. It is frequently nearly as long as the small, yellow mother larva and approximately half as long as the large, white larva.

The development of the embryo reacts upon the mother larva and she soon assumes a rather characteristic quiescent form, undoubtedly an outcome of her lowered vitality due to the rapid absorption of nourishment by the young. This results in the relaxing of the muscles, especially the transverse girdling bands at the margins of the segments. The change in the condition of the mother is probably explainable solely upon physiological grounds. The time elapsing between the assumption of the quiescent stage by the mother larva and the escape of the young is about seven days. The first part of this period the embryos rarely exhibit signs of life, though distinct motions of the head and anterior segments may be observed five days before they escape. The embryos are inclosed in the amniotic sac, which latter is ruptured before they escape from the body of the mother larva. There is a marked tendency among the embryos, when more than one occurs, to develop with their heads toward both extremities of the mother larva.

The growth of the embryo is correlated, as alluded to above, by interesting modifications in the mother larva. The large, well developed mother larva is easily recognized by her plump condition and the nearly solid, submedian masses of white adipose tissue filling the body from the fifth or sixth segment to the posterior extremity. Shortly after the escape of the embryos from the ovaries we observe clear patches (pl. 23, fig. 1), here and there in the mother larva, bordered by cells well filled with adipose tissue. Within a few days there is a striking modification and these large cells lose, probably by osmosis, a large proportion of the white, fatty matter and assume a somewhat reticulate character (pl. 23, fig. 2), which is soon followed by their disappearance, and the embryos absorbing practically all of the contents of the mother larva.

Records of individual embryos. The embryo in larva *A* was first detected January 17th. It then had a length about equal to two and one-half body segments of the mother larva. There was a distinct median streak of large, irregular cells, with a broad projection to one side near the anterior third, and a distinct cephalic cap of dark cells at the anterior extremity (pl. 32, fig. 1). The next day the germinal strip occupied an area approximately equal to one-third the width of the embryo (pl. 32, fig. 2), extending the following day to about half the width of the embryo, the clear space just behind the cephalic extremity being decidedly smaller. At this time the embryo had increased in length so that it extended from the posterior third of the fifth to the anterior fourth of the eighth body segment of the mother larva. There was some increase in length and minor changes in development from that date to the 27th, at which time there was a remarkable change, the germinal streak and its production to one side becoming narrower and being composed of unusually large cells; this change was soon followed by disintegration, the condition on the 28th being well illustrated on plate 32, figure 3.

The embryo of larva *B* was recognized January 17th, at which time it extended from the fourth body segment of the mother larva to the twelfth. The greater portion of the embryo consisted of a nearly uniform series of small, globular cells, though a darker area was visible on one side near the middle (pl. 34, fig. 1). Pulsations were visible in the body of the mother larva. The next day a series of moderately large, cuboidal cells were observed near the posterior extremity. This tissue became more distinct as development progressed, it becoming more evident by the 21st and occupying a still more prominent place the 23d and 24th. On this latter date two-thirds of the posterior portion of the embryonic body were filled with this tissue, somewhat as illustrated on plate 35, figure 2. The masses of adipose tissue on either side commenced to develop and eventually overspread and apparently absorbed in considerable measure the substances of the mesodermal tissue, a portion of which apparently develops into the ovaries. The embryonic digestive tract, apparently marked by large-celled tissue, appeared on the 27th to be nearly continuous throughout the entire length of the embryo. The embryo had shrunk a perceptible distance from the ends of the amniotic sac and the developing extremities were observed. The lobes of the antennae were recognized the following day as obtuse, buttonlike projections having a length less than three-fourths their diameter. Two days later the antennae had a length a little greater than their diameter; the ocular spots were indicated by indistinct, submedian, pigmented areas; the lobes of the brain could be traced; the salivary glands were submedian, narrowly lanceolate masses of large, glistening cells lying in presumably the sixth or seventh segments of the embryo, while the mesodermal tissue had retracted somewhat. The posterior extremity of the embryo was also well defined. February 1st there were three distinct rows of embryonic tissue, the two strips of adipose tissue and the large-celled mesoderm, the latter being less extensive the following day and largely obscured by adipose tissue on February 3d. There was a slow development from this time subsequently. On the 8th the ocular spots were light brown, diffuse, and the semitransparent mouth parts well developed, a fuscous appearance showing on the 9th. This embryo failed to escape from the mother larva.

The embryo in larva *C* extended from the third to the eleventh segments of the mother larva and had a distinct median streak January 17th. The latter on the 20th was seen to be composed of smaller, dark cells. The next day the embryo extended from the third to the middle of the twelfth segment of the mother larva. Development continued until the 27th, at which time it was nearly in the condition illustrated on plate 35, figure 2, the posterior portion being largely occupied by the mesodermal tissue. The an-

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terior five or six segments of the embryo were semitransparent and the ocular spots represented by minute, brownish, submedian, pigmented areas. The next day the three-rowed condition, indicating the development of adipose tissue, was more apparent, while the lobed posterior extremity of the embryo was fairly definite. On the 30th developing salivary glands were distinguished near the anterior extremity of the adipose tissue. Free movements of the embryo were noted the 31st, and on February 1st it was seen that the head was well developed though semitransparent, the antennae having a length twice the diameter. The mesodermal tissue was obscured or absorbed to a considerable extent by the developing sublateral masses of adipose tissue. The head of the embryo was slightly infuscated on the 2d and the ocular spots purplish brown. Free movements of the embryo continued and on the 6th the mesoderm was largely concealed by adipose tissue. There was comparatively little development from this date onward, though the embryo continued active in the mother larva till the 10th. Owing probably to an insufficient supply of oxygen it was unable to escape.

One larva (*H*) separated January 17th, contained two embryos, each with a length about half that of the mother larva and both showing a distinct infolding near the middle of the germinal streak. The posterior extremities of these embryos showed several exceptionally large, compound cells — polar cells. Six were observed in the anterior embryo and apparently three in a row in the posterior embryo, the latter apparently moving anteriorly. Unfortunately this promising larva was accidentally destroyed.

Larva *I*, isolated January 17th, contained an embryo extending from the fifth to the eleventh body segments of the mother larva. The next day four presumably polar cells were recognized at the posterior extremity. There were no evident streaks in the embryo. On the 19th one very large aggregation of unusually dark cells was observed just before the posterior extremity, the opposite extremity being largely filled with globular ectodermal cells, especially abundant on one side. The following day a distinct tract of darker tissue was observed on one side of the embryo, extending from its anterior third to its posterior fifth and representing approximately the area occupied by the mesodermal tissue. January 21st the embryo extended from the fifth to the anterior margin of the thirteenth segment of the mother larva. There was a distinct fold of ectodermal tissue, presumably in the region of the eighth to the twelfth embryonic segments, extending a little over half the width of the embryo. Posteriorly there were several large, globose, nucleated cells, presumably polar cells, while at the opposite end there was a considerable mass of large cells having a diameter of one-fourth to one-third that of the embryo. Two days later the posterior extremity of the embryo contained a mass of large-celled tissue in which were several larger, indistinct, presumably polar cells. The large, glistening mesodermal tissue was observed in the region of the ninth to the twelfth segments, while the sublateral developing adipose tissue was seen on either side. This condition is well shown in a photograph taken the following day (pl. 35, fig. 2), at which time the embryo exhibited distinct movements. The rather well formed head was colorless and moved from side to side. Streaming of the body contents was observed though the fat bodies occupied a comparatively small space on either side. The fine-celled, slender, malpighian tubes were noted. The posterior extremity had well developed lobes. On the 25th the median mass of mesodermal tissue had begun to contract, the developing adipose tissue increasing considerably. Two days later the head was well developed; the ocular spot black; the salivary glands were recognized; the malpighian tubes were distinct, while the mesodermal tissue extended approximately from the tenth to the twelfth segments and had a width only about one-fourth the diameter of the embryo. The following day the embryo escaped from the mother larva.

Larva *N* was a small, yellow larva separated January 30th and containing an embryo extending from the posterior third of the ninth to the posterior third of the eleventh segment of the mother larva. The embryo exhibited a distinct germinal strip extending from the anterior third to the posterior fourth and with a broad band of ectodermal tissue extending to one side and including approximately the middle of the embryo. The anterior extremity of the embryo is capped as it were with dark-celled tissue, while large yolk cells may be seen here and there in the germ plasma. This embryo was about as far advanced as the one illustrated on plate 32, figure 4. The next day there was a median germinal strip of lighter cells and on one side a layer of decidedly darker cells, much as shown in plate 30, figure 1. February 1st the two layers described above were more distinct and broader, the median lighter one being crowded a little to one side by the greater development and consequent breadth of the darker ectoderm, which latter extended almost to the middle of the embryo and from its anterior third to its posterior fourth. The anterior extremity of the embryo is characterized by irregular series of moderately large cells in the germ plasm. February 2d the median mesodermal tissue was crowded still further to one side by the darker ectoderm which now extends to the middle of the embryo and appears to have elongated somewhat. Both extremities of the embryo have retracted a little from the tip of the amniotic sac and are occupied by irregular series of large cells. The following day the mesoderm was crowded still further to one side by the darker ectoderm. At the anterior extremity of the embryo there was a mass of rather dark, fine-celled tissue, possibly the corpus luteum and apparently separating by fission, while the greater portion appears to be composed of globular, highly refractive cells grouped much as at the posterior extremity, which latter is narrowly margined by rather large, highly refractive, indistinctly grouped cells, one or more being unusually large. February 4th there was a distinct clear space in each extremity of the amniotic sac. The anterior extremity of the embryo is distinctly lobed, the broader, less produced portion capped with a mass of large, refractive cells, the small protuberant lobe composed of fine tissue. The posterior extremity of the embryo is distinctly bilobed. Unfortunately the numerous changes observed in this embryo from this point on at least appear to be abnormal, since the embryo disintegrated February 9th, though pulsations in the mother larva continued normally till the 15th.

A very interesting embryo was discovered in larva *Y* February 6th. The embryo extended from the seventh to the eighth abdominal segments and had a length equal to nearly twice the diameter of the mother larva. It was narrowly elliptical, with a length approximately three times its diameter. The polar cells, though visible, were not so conspicuous as in the younger embryo illustrated on plate 30, figures 2 and 3. This embryo is composed of nearly uniformly developed, rather transparent, semicuboidal, ectodermal cells. At the anterior extremity there was a slight thickening, apparently the much reduced cells of the corpus luteum. The median portion was occupied by a rather broad streak of dark, granular cells bordered on either side, including the extremities, by lighter, smaller-celled tissue. The mother larva was alive, as evidenced by distinct pulsations. The following day a distinct though small cap of cells was observed at the anterior extremity of the embryo. At the posterior third of the embryo there was a distinct constriction, almost a division, the tissues adjacent thereto being markedly larger and darker, while at the posterior extremity there was a distinct lobe occupying about two-thirds the width of the embryo. February 8th there was a shrinking from both extremities of the amniotic sac, and other changes which are not described in detail, since they appeared to be preliminary to disintegration the next day, though the mother larva continued alive until the 15th.

An active, moderate-sized, white larva was isolated February 27th and its granular ovaries were seen partially to divide into irregular lobes, the one at the posterior extremity of the left developing into an ovum larger than the remainder of the ovary. The anterior third of the ovum was filled with darker, granular matter, while the remainder consisted of clear plasm containing about seven large, nucleated cells. This ovum increased in size until it was larger than the remainder of the ovary in which it originated, gradually separating therefrom by fission and shortly developing into a small embryo in the morula stage with distinct polar cells much as is illustrated on plate 30, figures 2 and 3.

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EXPLANATION OF PLATES

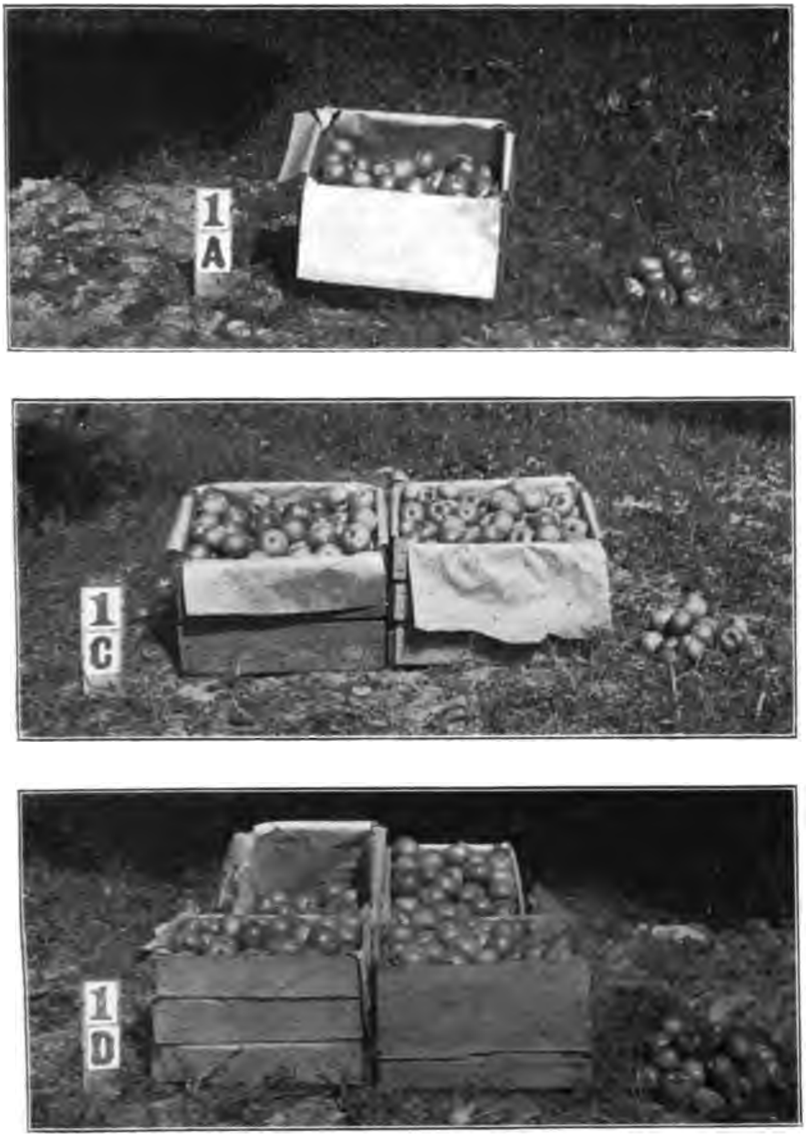
PLATE 1

Codling moth work

Sprayed but once

1*a* Picked fruit: 135 sound, 13 wormy apples
1*c* Picked fruit: 382 sound, 27 wormy apples
1*d* Picked fruit: 563 sound, 30 wormy apples

Plate 1



Sprayed apples

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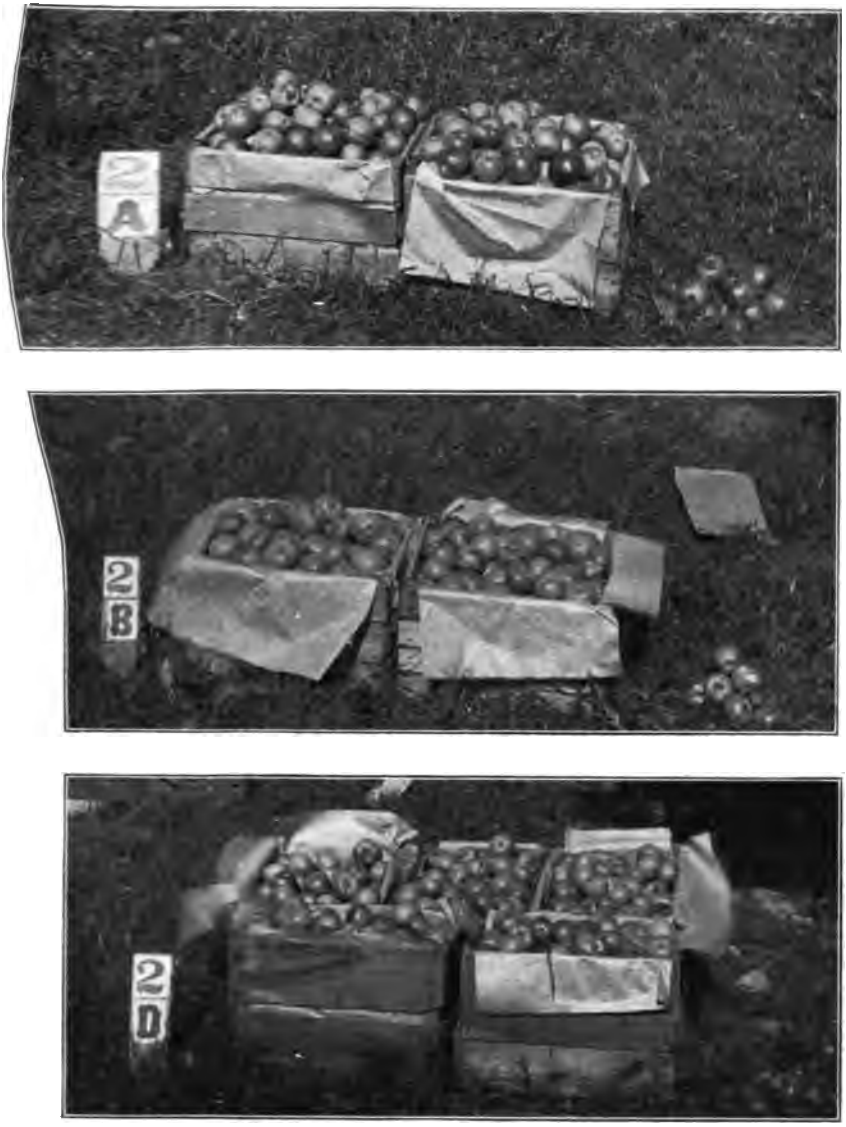
PLATE 2

Codling moth work

Sprayed twice

2a Picked fruit: 414 sound, 27 wormy apples
2b Picked fruit: 347 sound, 15 wormy apples
2d Picked fruit: 941 sound, 13 wormy apples

Plate 2



Sprayed apples

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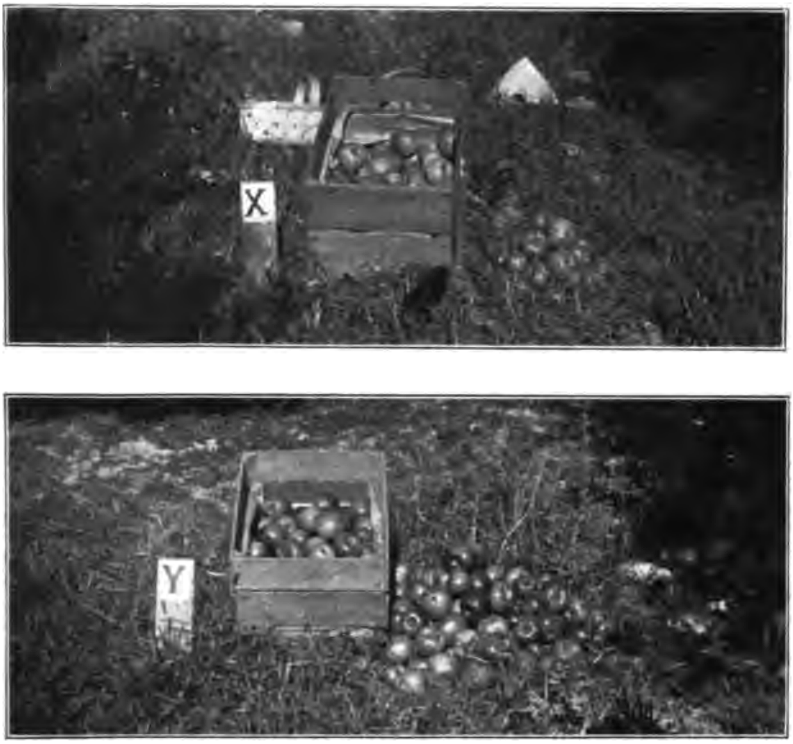
PLATE 3

Codling moth work

Unsprayed or check trees

X Picked fruit: 86 sound, 69 wormy apples
Y Picked fruit: 97 sound, 233 wormy apples

Plate 3



Unsprayed apples

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TILDEN FOUNDA

PLATE 4

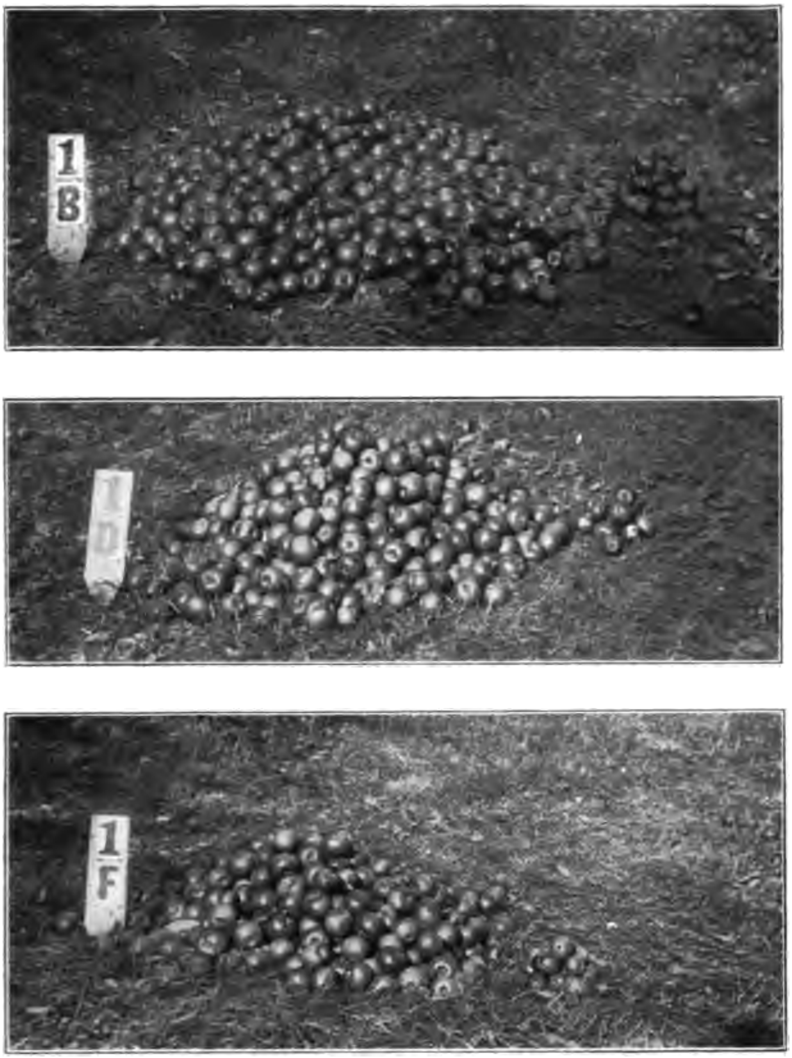
III

Codling moth work

Sprayed but once

1b Picked fruit: 1394 sound, 117 wormy apples
1d Picked fruit: 703 sound, 82 wormy apples
1f Picked fruit: 596 sound, 66 wormy apples

Plate 4



Sprayed apples

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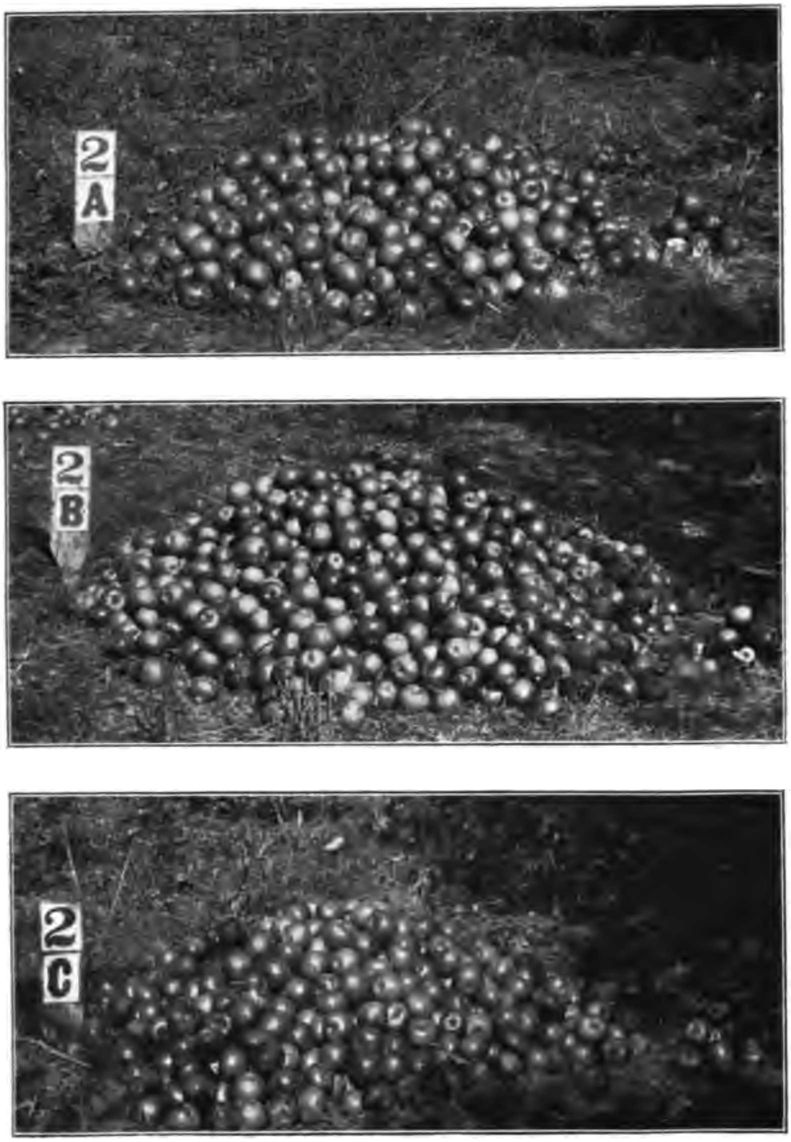
PLATE 5

Codling moth work

Sprayed twice

2a Picked fruit: 658 sound, 51 wormy apples
2b Picked fruit: 1501 sound, 88 wormy apples
2c Picked fruit: 760 sound, 52 wormy apples

Plate 5



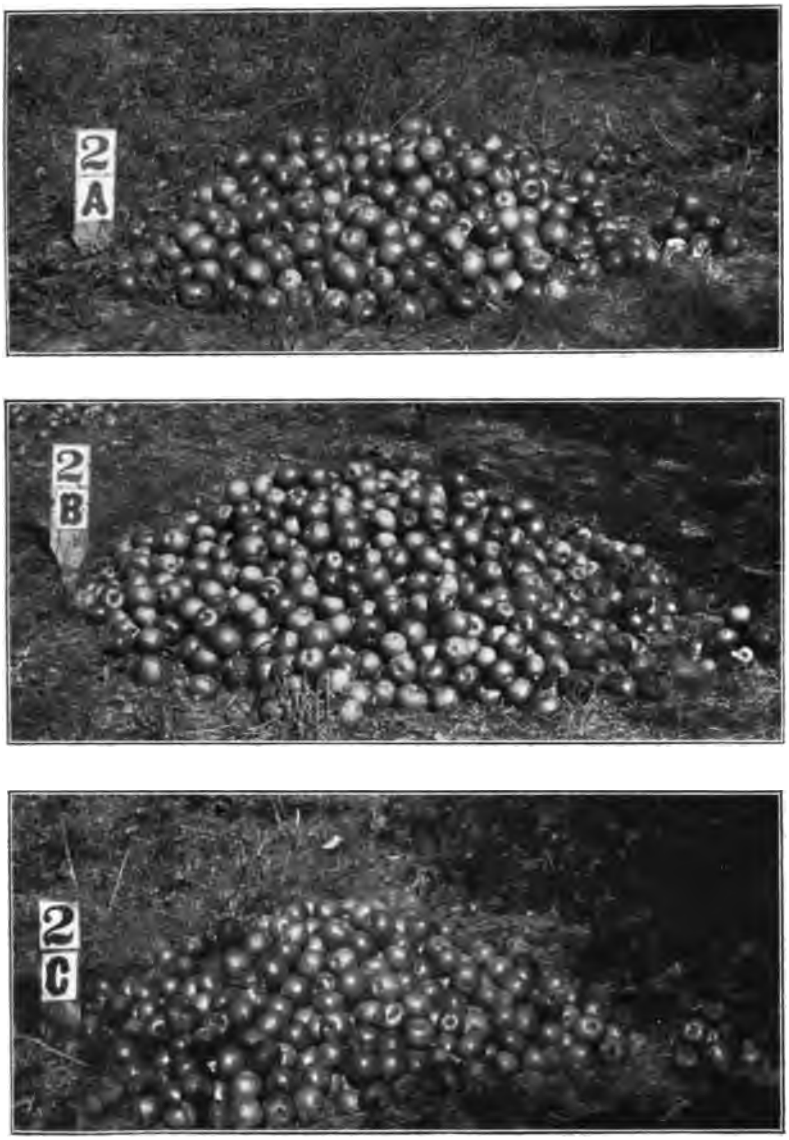
Sprayed apples

Codling moth work

Sprayed twice

2a Picked fruit: 658 sound, 51 wormy apples
2b Picked fruit: 1501 sound, 88 wormy apples
2c Picked fruit: 760 sound, 52 wormy apples

Plate 5



Sprayed apples

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PLATE 6

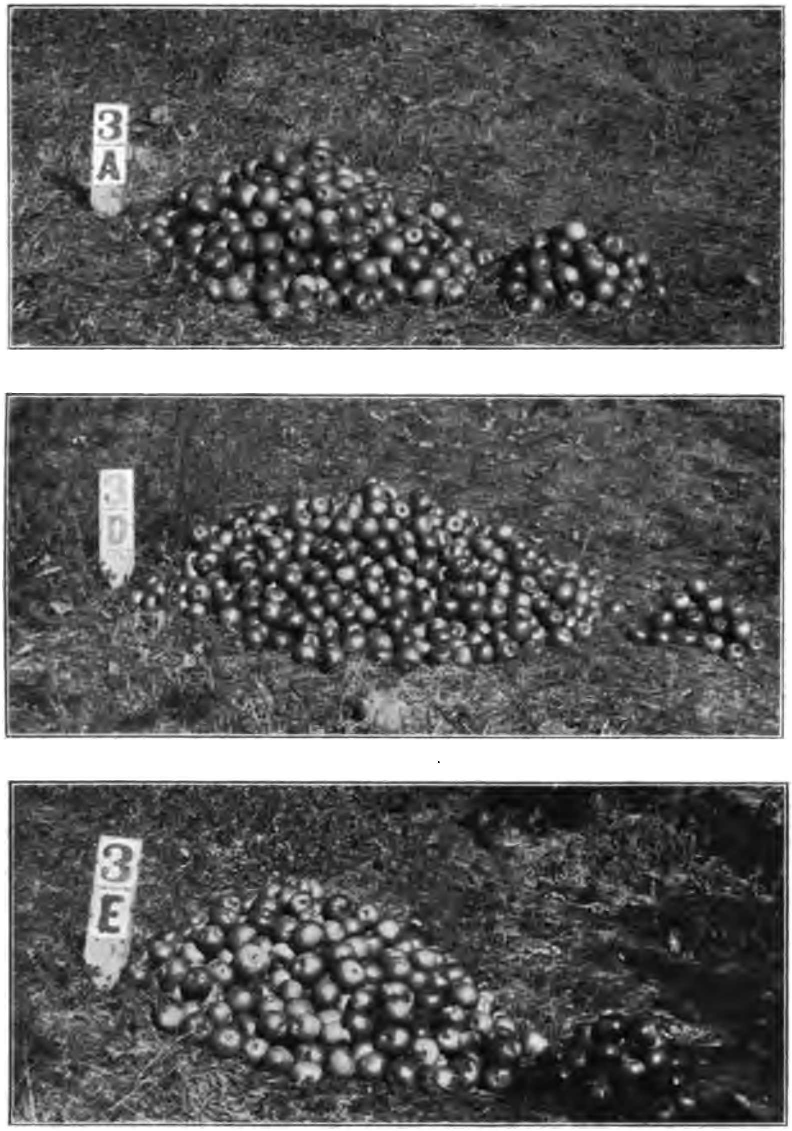
Codling moth work

One late spraying

3a Picked fruit: 392 sound, 198 wormy apples
3d Picked fruit: 830 sound, 128 wormy apples
3e Picked fruit: 467 sound, 163 wormy apples

116

Plate 6



Sprayed apples

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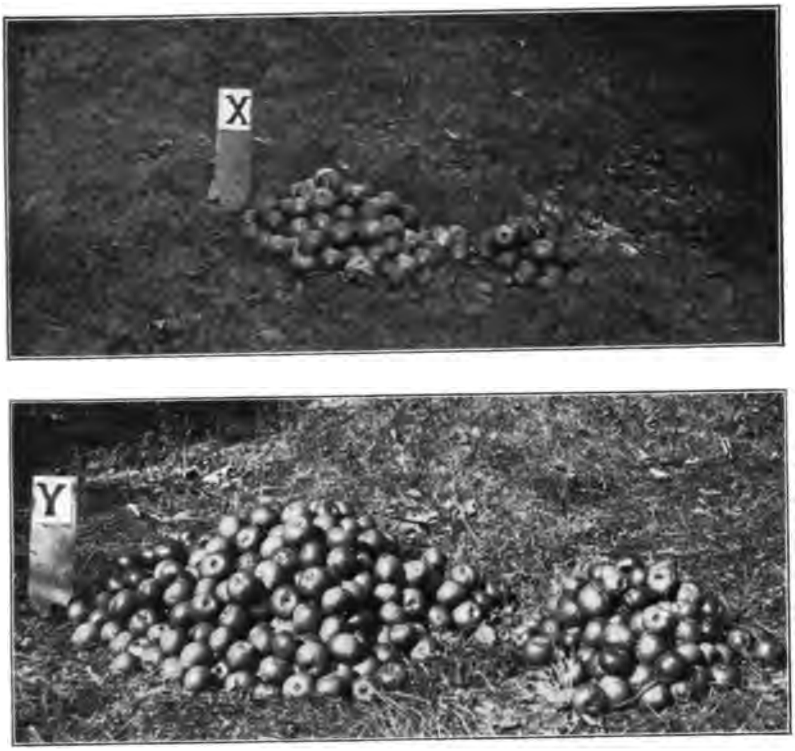
PLATE 7

Codling moth work

Unsprayed or check trees

X Picked fruit: 120 sound, 47 wormy apples
Y Picked fruit: 317 sound, 325 wormy apples

Plate 7



Unsprayed apples

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PLATE 8

Codling moth work

Upper figure, Wealthy tree in series 3
Lower figure, Mackintosh tree in series 3, also showing yield of tree 2Y; 125 sound, 250 wormy apples

Plate 8

1

2

Experimental trees

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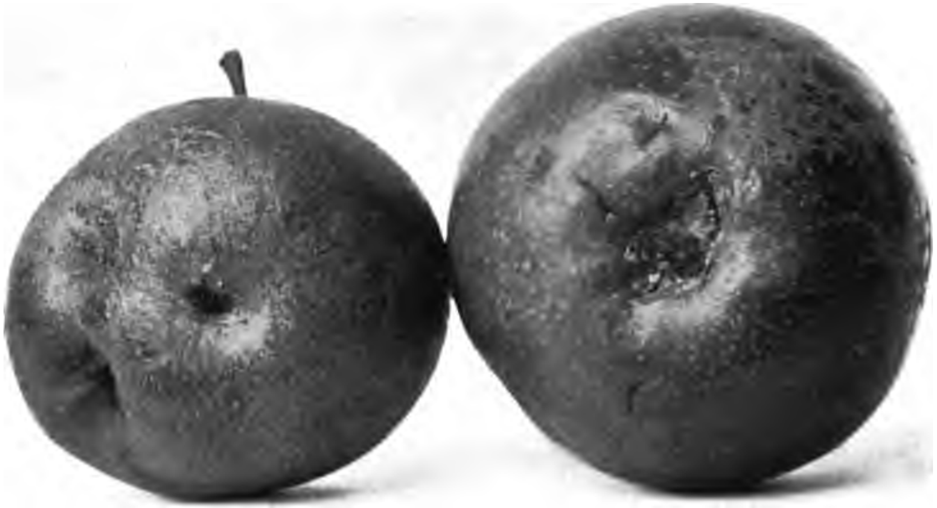
PLATE 9

Codling moth work

Apples showing the characteristic end wormy infestation, also one which has been entered at a slight depression by a larva of the second brood

Plate 9



Wormy apples

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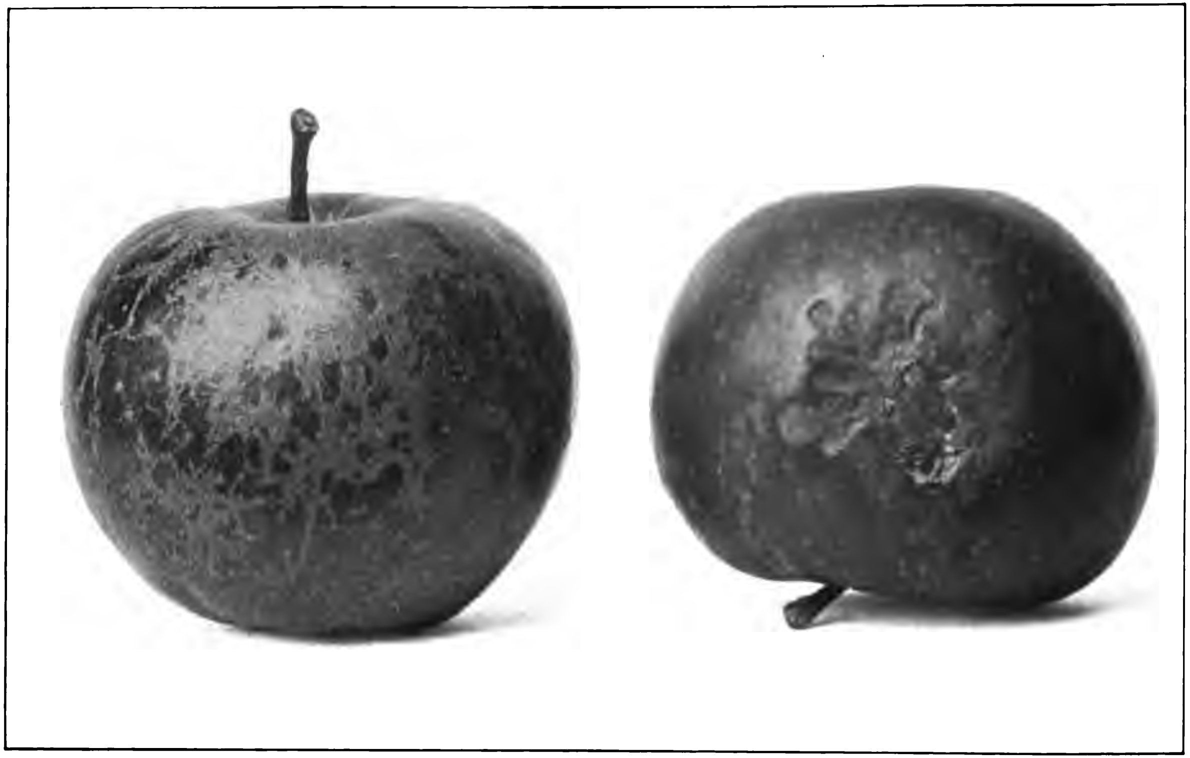
PLATE 10

Codling moth work

1 Baldwin showing a moderate amount of bordeaux injury
2 Work of Tortricid followed by codling moth injury

Plate 10



Russeted and wormy fruit

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TILDEN FOUNDATIONS.

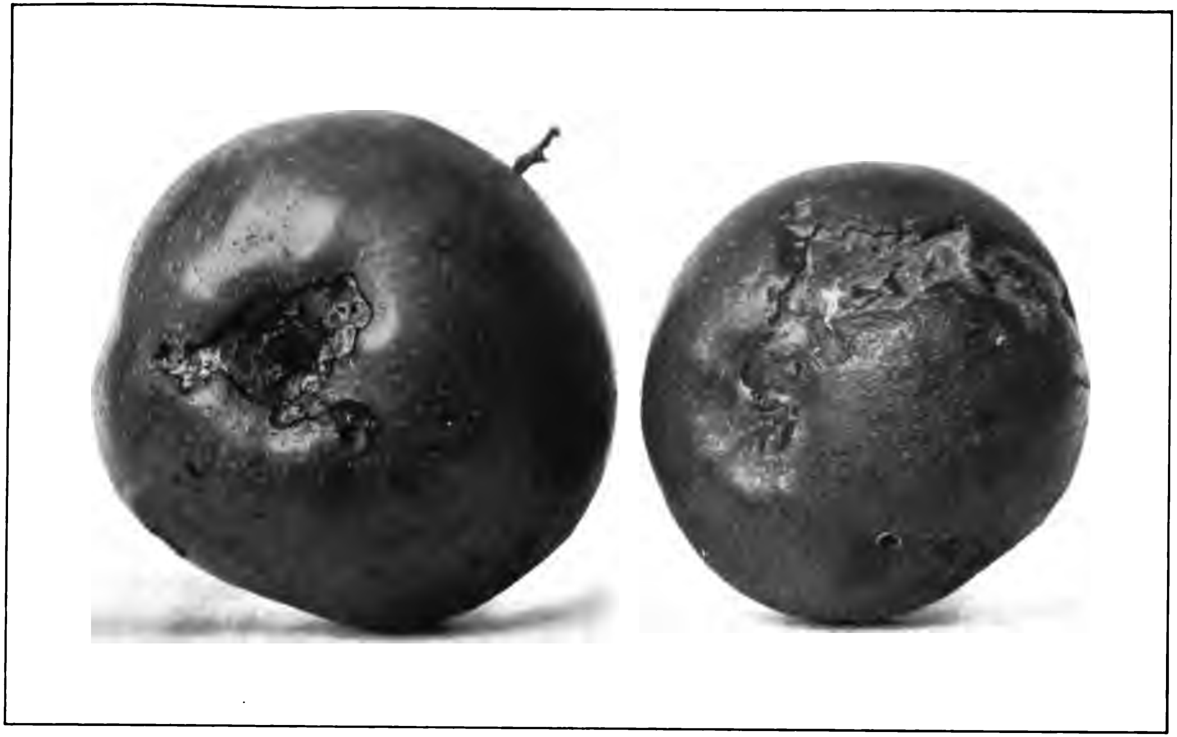
PLATE 11

Codling moth work

Two apples showing work of Tortricid

1 The operations of the insect about the blossom end
2 Its feeding near the end and upon the side of the apple

Plate 11



Work of Tortricid on apples

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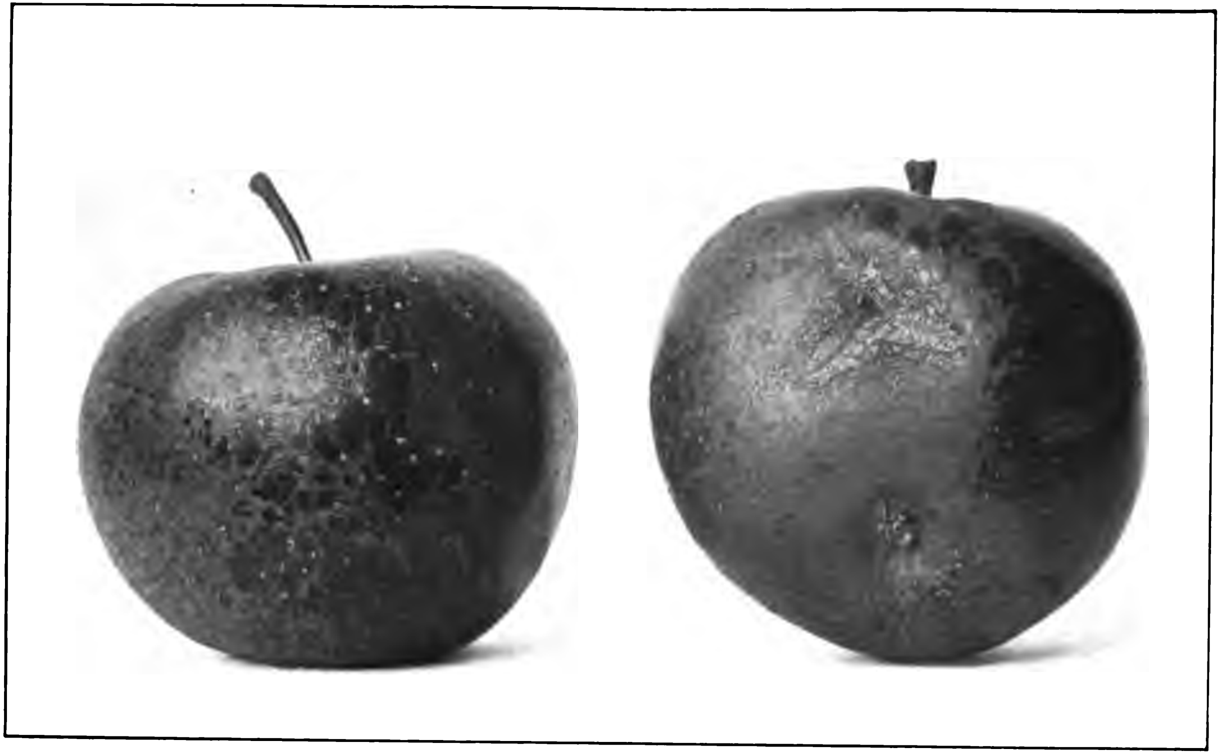
PLATE 12

Codling moth work

1 Baldwin showing a moderate amount of injury by bordeaux mixture
2 Baldwin with more severe injury and incipient cracking, a codling moth entrance in the middle of a crack

Plate 12



Russeting and codling moth injury

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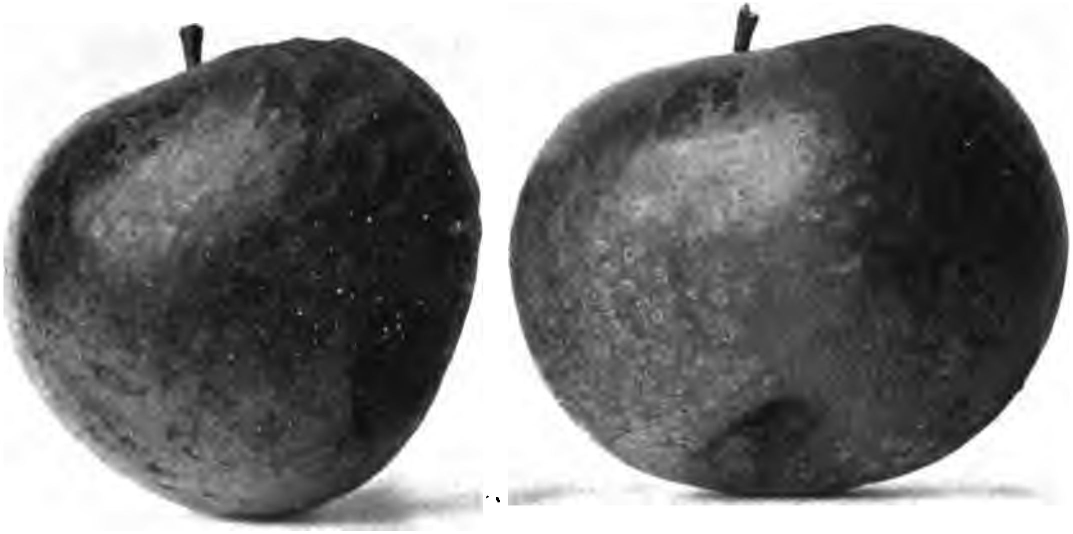
PLATE 13

Codling moth work

1 Asymmetrical Ben Davis with one side badly deformed, probably from injury by bordeaux mixture

2 Another apple badly injured though not deformed by bordeaux mixture

Plate 13



Russeted fruit

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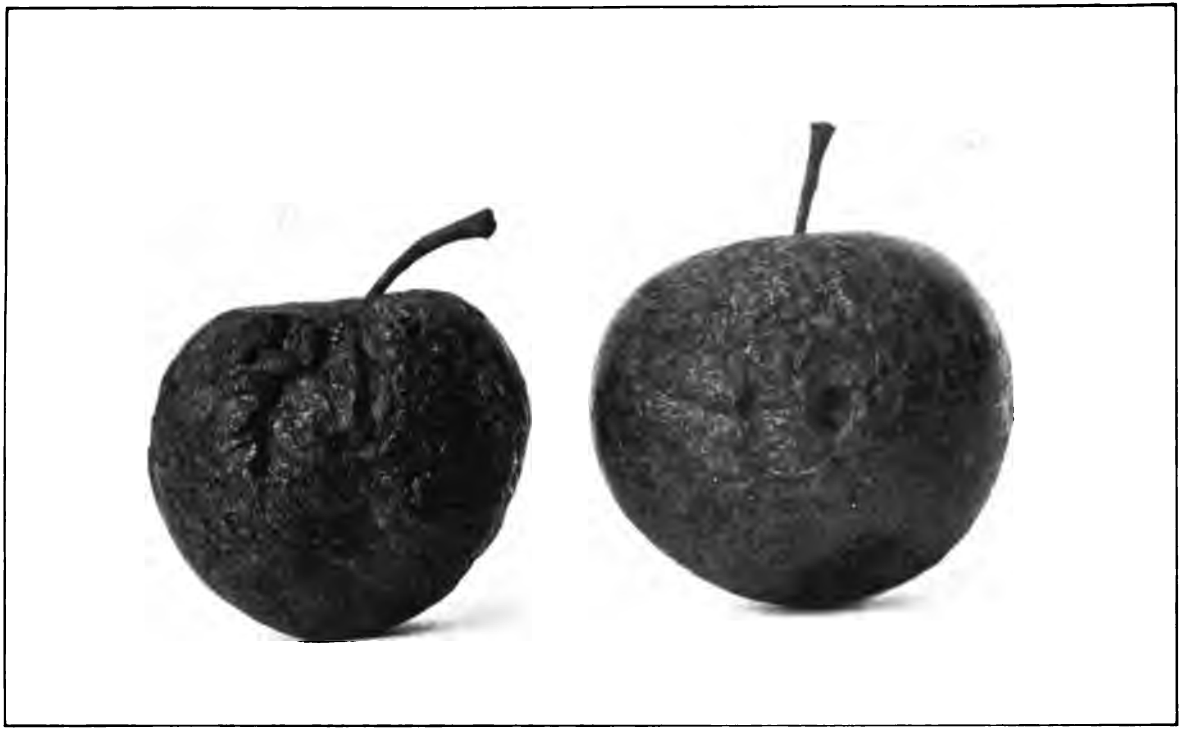
PLATE 14

4a

Codling moth work

Badly checked apples on unsprayed trees. Such crevices are favorite points for entry by codling moth.

Plate 14



Russeted and checked fruit

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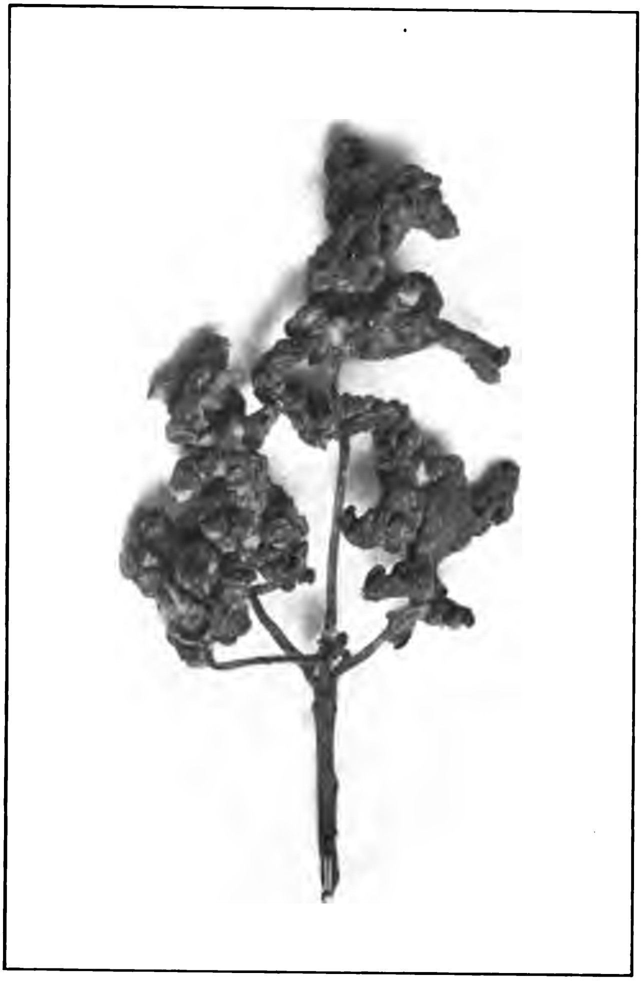
PLATE 15

Psyllopsis fraxinicola Först.

Distorted ash leaves, showing work of this species

134

Plate 15



Work of ash psylla

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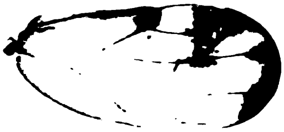
PLATE 16

Psyllopsis fraxinicola Först.

1 Anterior wing, male. x 15
2 Posterior wing, male. x 15
3 Apex of male abdomen, showing genitalia. x 20
4 Apex of female abdomen, showing ovipositor and accessory organs. x 20
5 Head. x 15
6 Antenna, portion of anterior leg and part of rostrum of female. x 30

Plate 16



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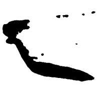

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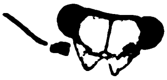

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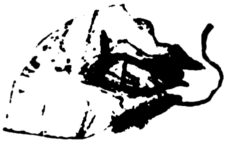

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Ash psylla

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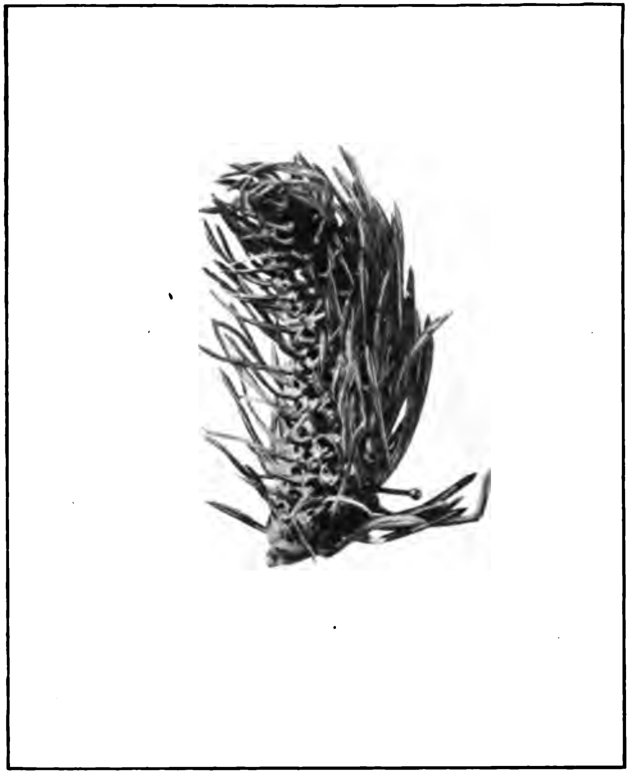
PLATE 17

1 Gall of Chermes cooleyi Gill. on blue spruce, natural size
2 A portion of a printed page showing a crane fly which had been pressed into the paper in the calendering process. Natural size

Plate 17



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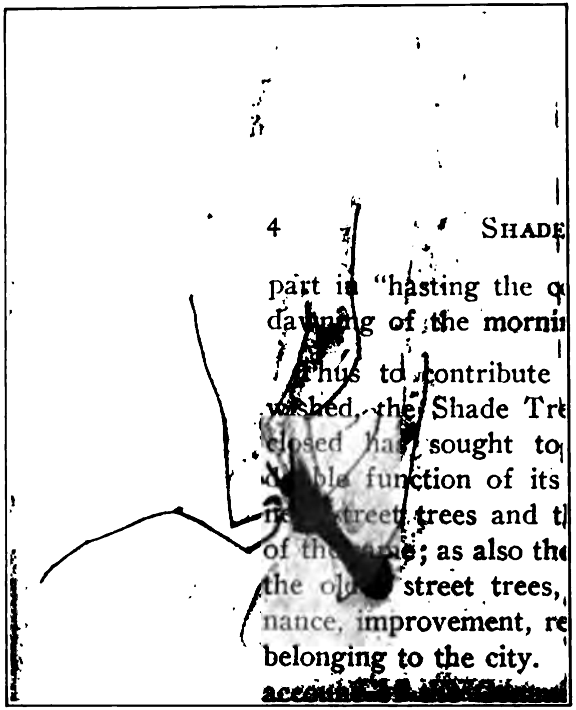

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Spruce gall and crane fly

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PLATE 18

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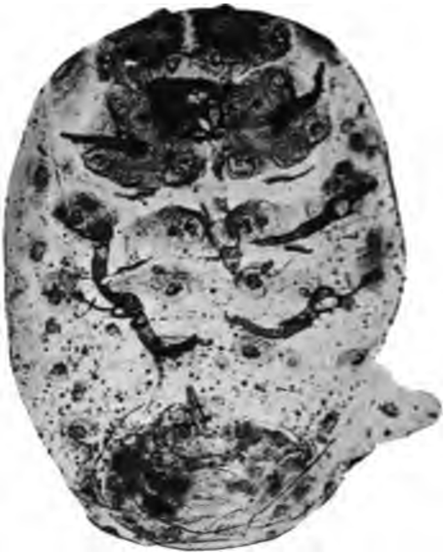
Plate 18



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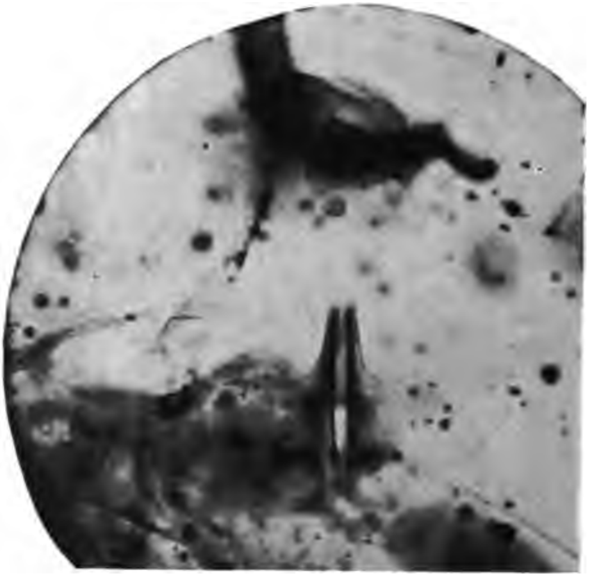

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Silver fir aphid

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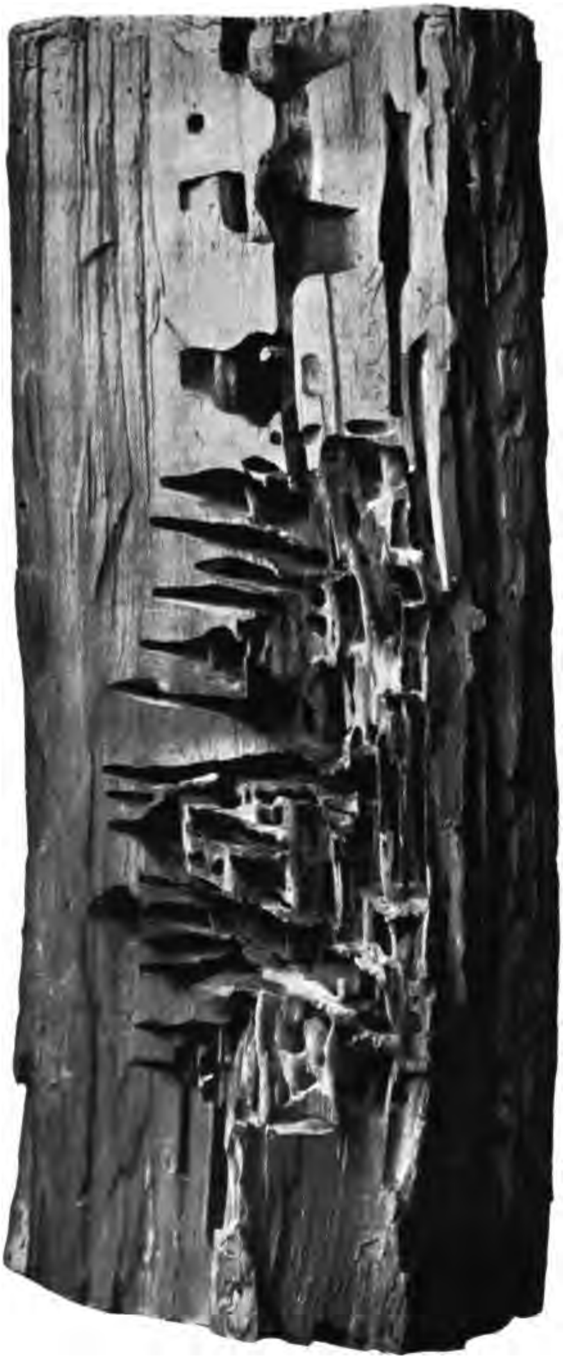
PLATE 19

Camponotus herculeanus Linn.

Work of carpenter ant in poplar

142

Plate 19



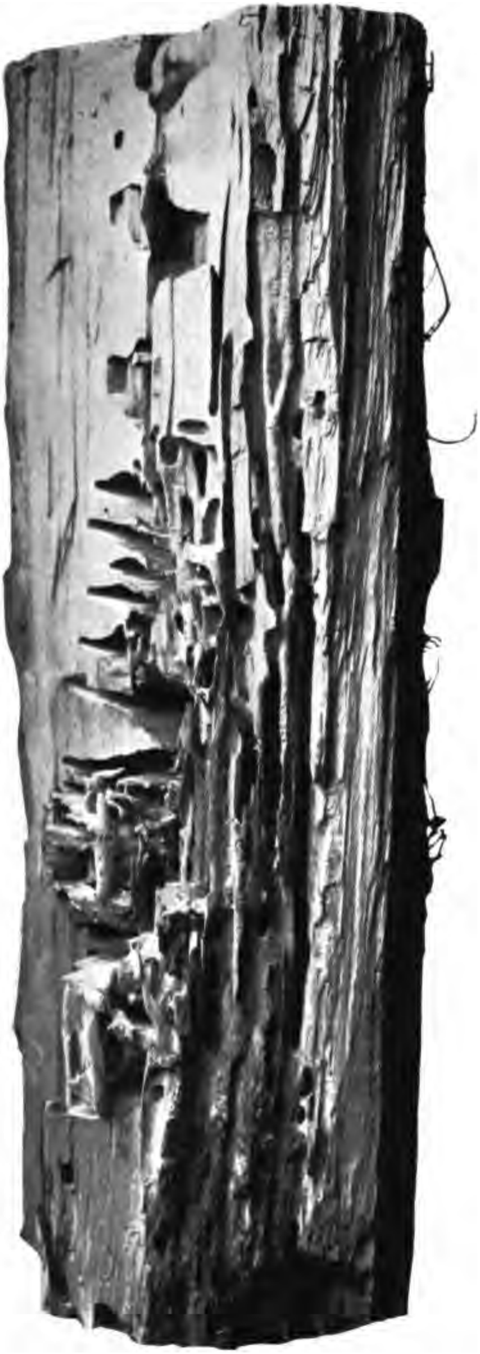
Work of carpenter ant

PLATE 20

Camponotus herculeanus Linn.

Work of carpenter ant in poplar; another view

Plate 20



Work of carpenter ant

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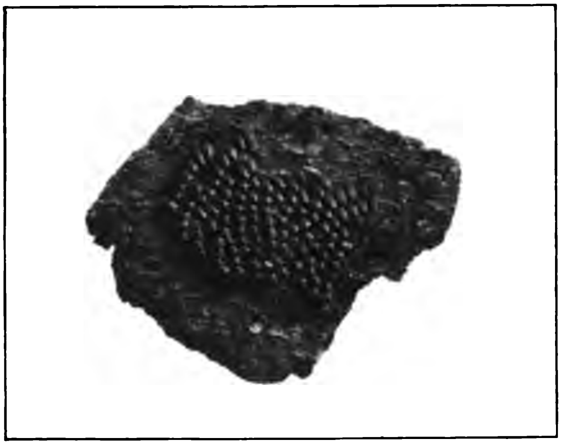
PLATE 21

Snow-white linden moth

1 Snow-white linden moth; eggs, slightly enlarged
2 Adult moths

Plate 21



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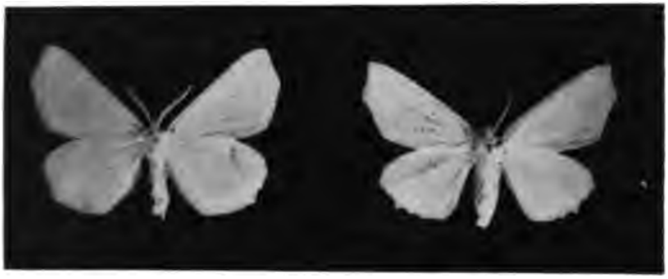

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Snow-white linden moth

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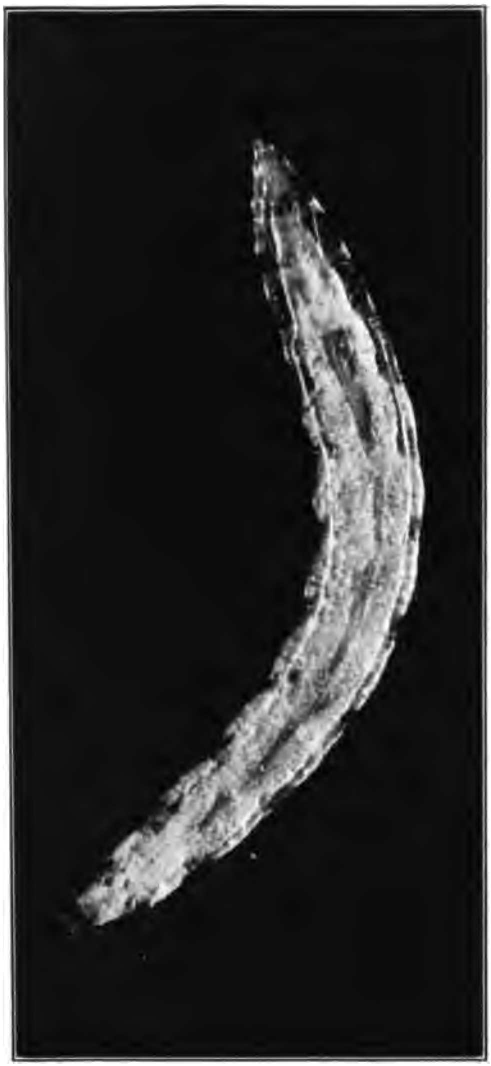
PLATE 22

Miastor ? americana Felt

1 Large, white, living larva chilled. Photographed by reflected light. x 50

Plate 22



Miastor larvae

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TILDEN FOUNDATIONS.

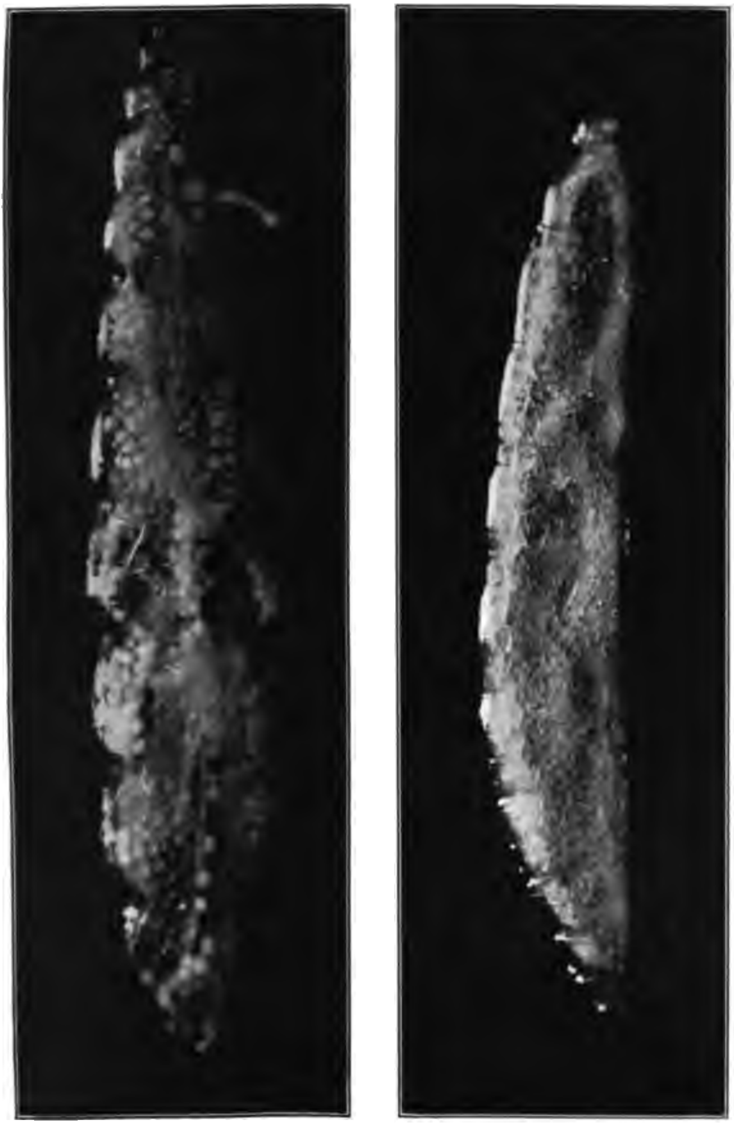
PLATE 23

Miastor ? americana Felt

1 Mother larva containing a number of semitransparent embryos. Note cells well filled with adipose tissue. x 50. By reflected light

2 Mother larva containing several semitransparent embryos. Note comparatively few large cells filled with adipose tissue. x 50. By reflected light

Plate 23



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Miastor larvae containing embryos

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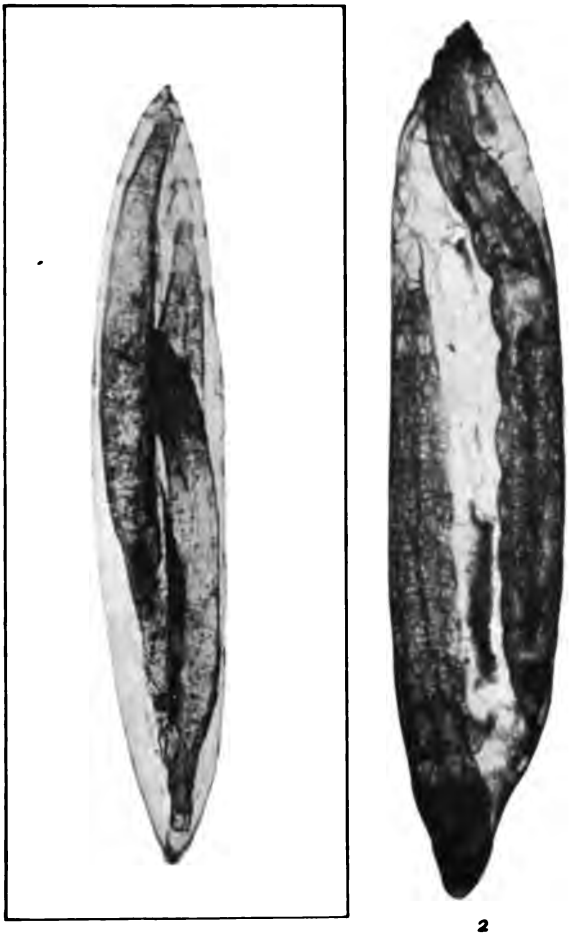
PLATE 24

Miastor ? americana Felt

1 Mother larva containing several nearly developed embryos. x 50

2 Mother larva containing two nearly developed embryos. Note columns of large cells. x 50

Plate 24



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Embryos in Miastor larvae

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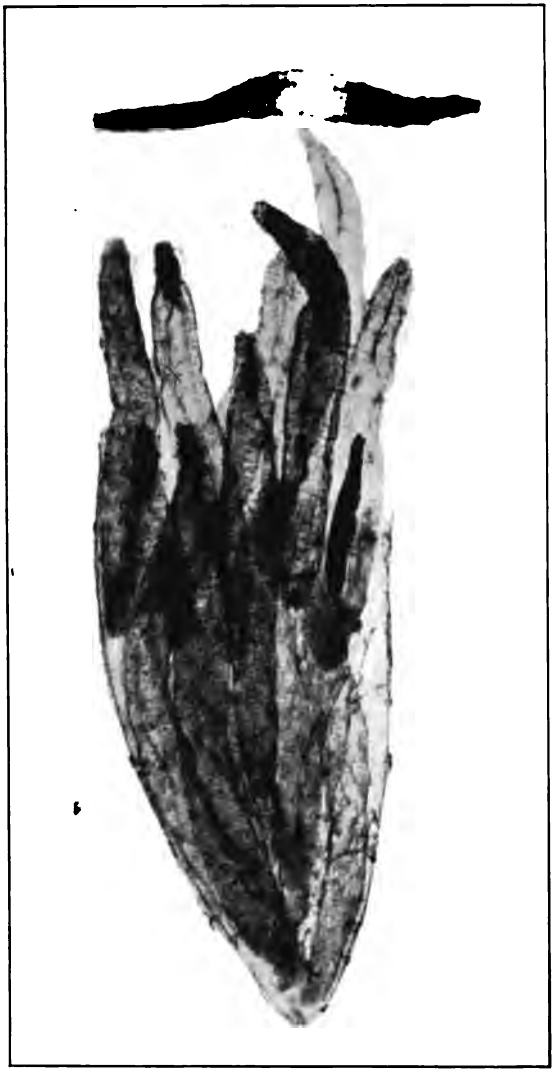
PLATE 25

Miastor ? americana Felt

Posterior extremity of a large mother larva filled with numerous embryos, one lying free across the broken end. x 100

Plate 25



Miastor embryos

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TILDEN FOUNDATIONS

PLATE 26

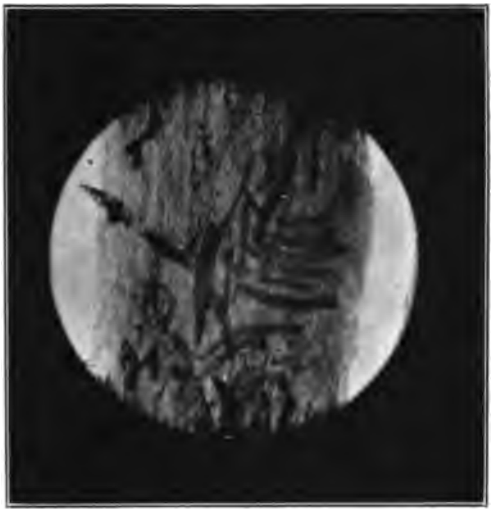
Miastor ? americana Felt

1 Portion of chip showing a number of Miastor larvæ. x 20

2 Head and anterior body segments of larva, showing the shape of the head, with the anterior third fuscous, the short, diverging antennae, the ocular spot and the lobed brain. x 120

3 Posterior extremity of larva, showing cuticular processes at its apex. x 50

Plate 26



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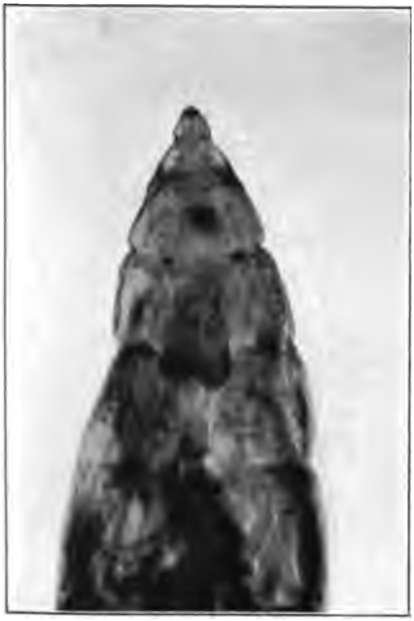

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Miastor larvae

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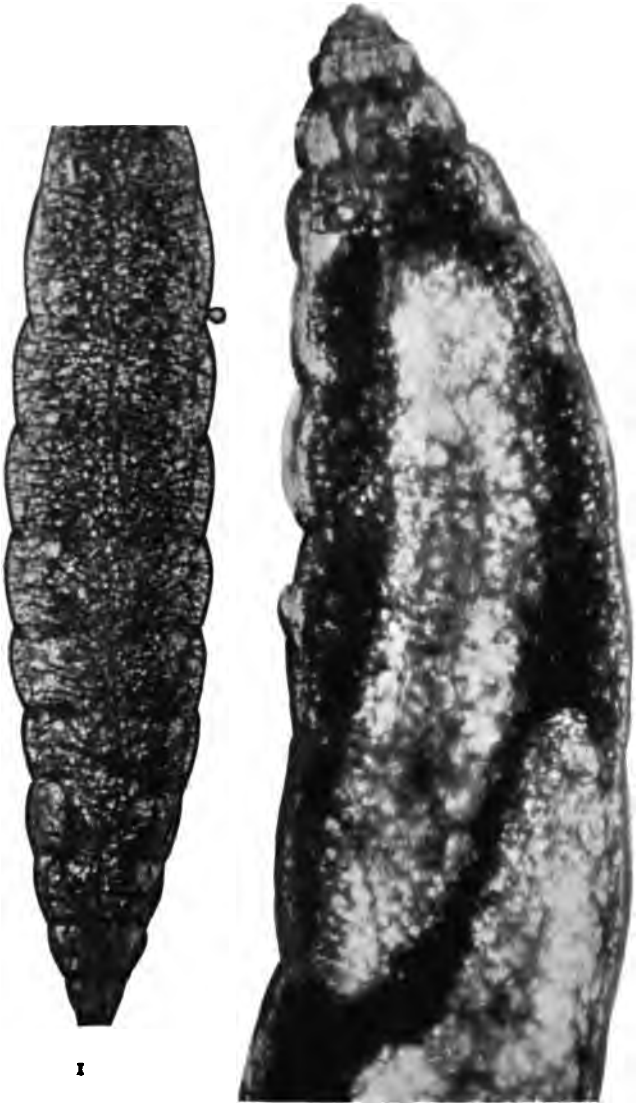
PLATE 27

Miastor ? americana Felt

1 Mother larva filled with partly broken down adipose tissue, the embryos concealed beneath. x 50

2 Embryo in mother larva, showing general outline and an indistinct segmentation along the germinal streak. x 120

Plate 27



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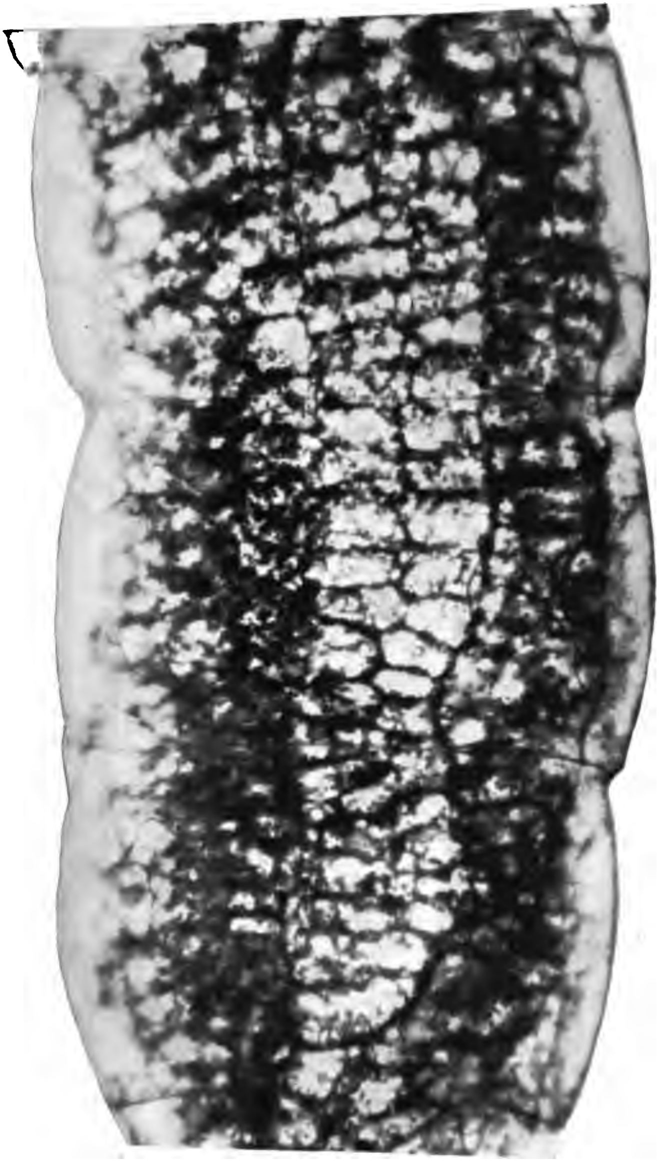
Miastor larvae

PLATE 28

Miastor ? americana Felt

Three segments of a large, white mother larva, showing series of cuboidal cells. x 200

Plate 28



Portion of Miastor larvae

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PLATE 29

Miastor ? americana Felt

1 Ovary of mother larva. Note the large-celled, oval mass of tissue near the discolored area. x 325

2 Portion of a band of spines. x 325

Plate 29

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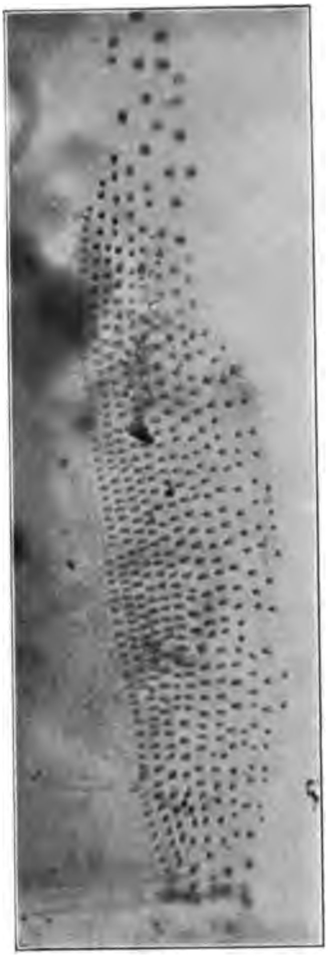

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Miastor larvae

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PLATE 30

5

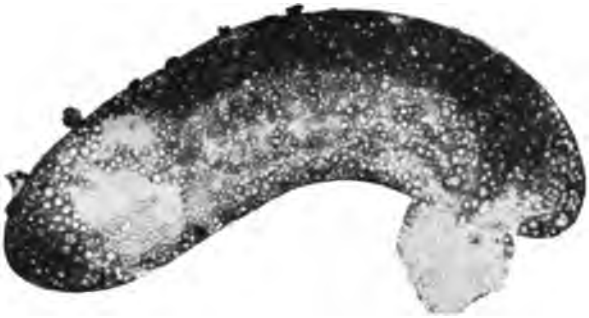
Miastor ? americana Felt

1 Young embryo dissected from a large mother larva and showing a darker strip of ectoderm, a lighter mesodermal area and a dark mass of tissue at the anterior extremity toward the left. x 100

2 Young living embryo lying mostly in the ninth segment of a small, yellowish mother larva. Note the large polar cells at the lower posterior extremity. x 200

3 The same, more enlarged. x 400

Plate 30



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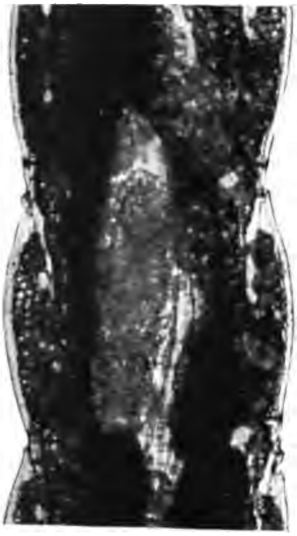

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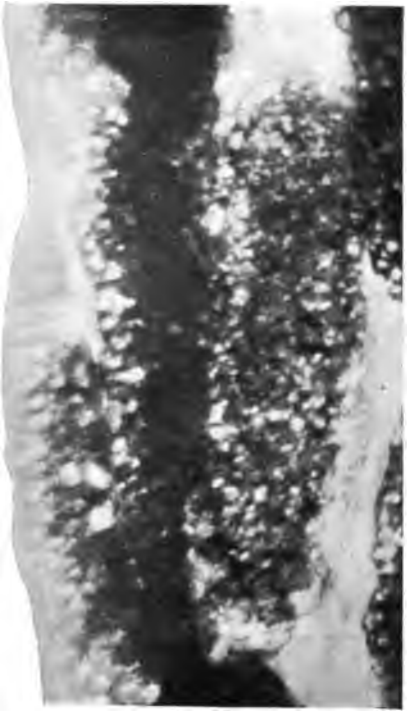

Miastor embryos 3

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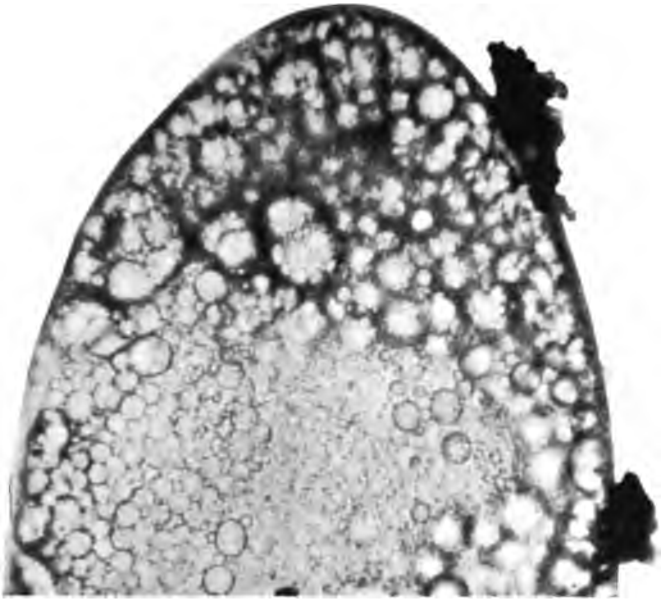
PLATE 31

Miastor ? americana Felt

1 Anterior extremity of embryo illustrated in figure 1 of the preceding plate. x 300

2 Middle portion of same embryo. x 300

Plate 31



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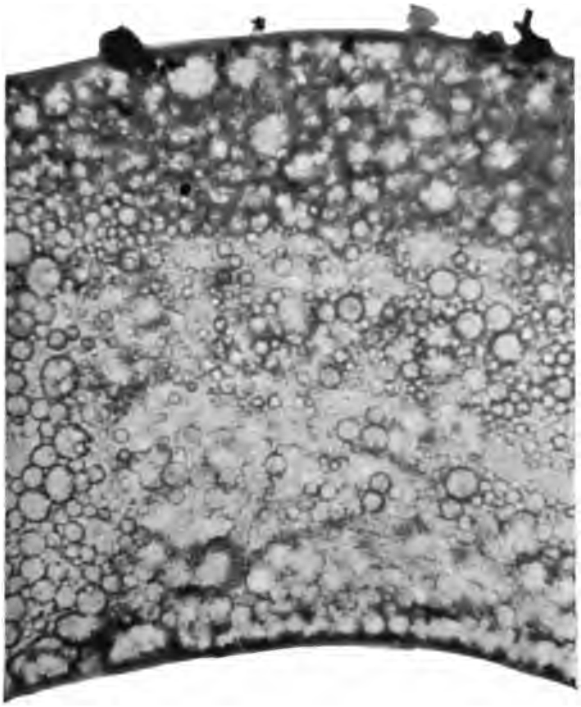

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Miastor embryos

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PLATE 32

Miastor ? americana Felt

1 Living embryo within a small, yellowish larva. Note the distinct germinal streak with its broad projection to one side near the anterior third, and the cephalic cap of fuscous cells. x 100

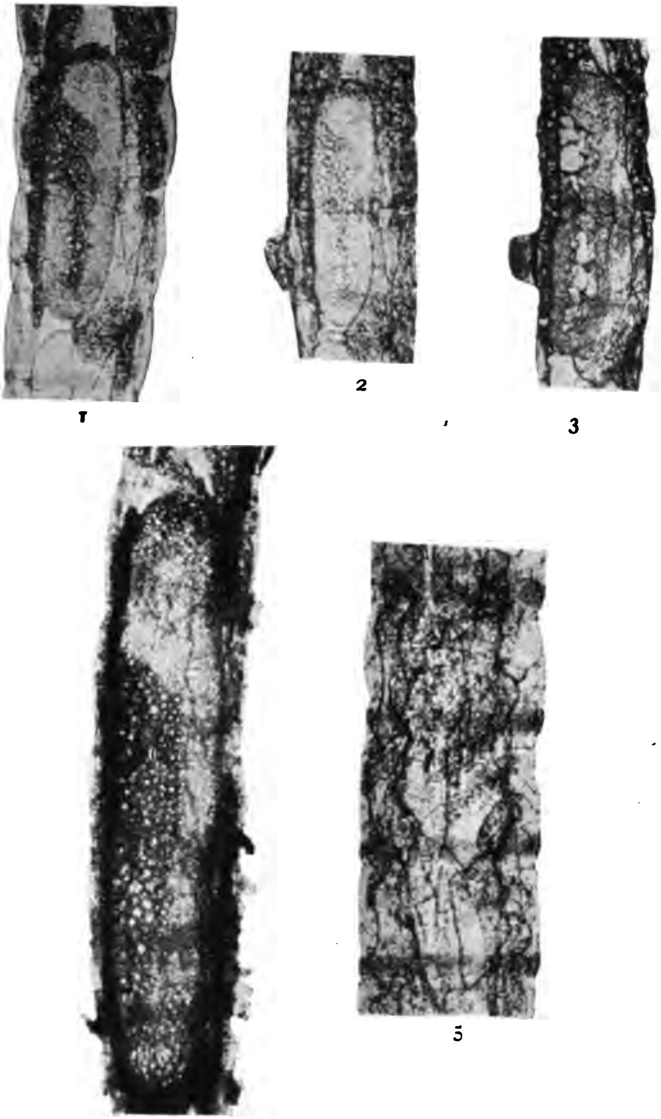
2 The same embryo photographed 24 hours later and showing some change. This photograph was relatively not as good as the first. x 100

3 The same embryo several days later showing the condition after disintegration has begun. x 100

4 A larger embryo in a small, yellow mother larva extending from her fifth to eighth body segments. Note the great extension of the ectoderm from about the anterior fourth to the posterior fifth, and the cephalic cap of dark cells. x 100

5 Empty skin of a portion of a mother larva. The irregular, dark, longitudinal lines represent tracheae while the transverse fuscous bands are spines on the segments. x 100

Plate 32



1 2 3 4 5

Miastor embryos

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PLATE 33

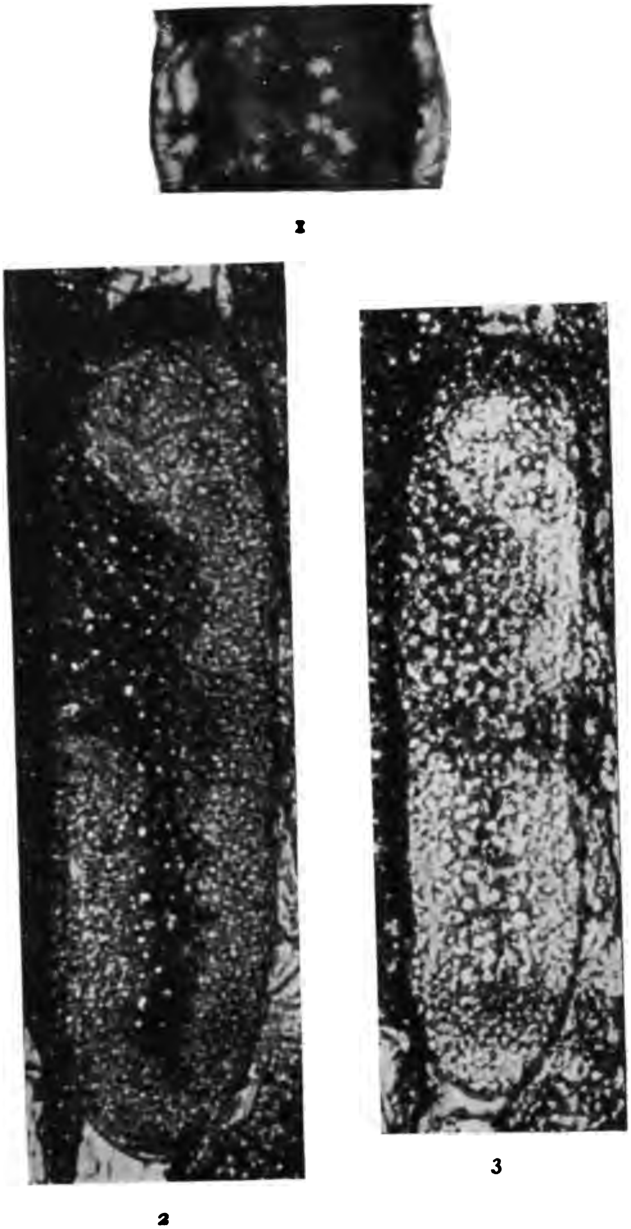
Miastor ? americana Felt

1 A portion of a segment of the larva illustrated on plate 35, figure 1 showing the character of the large-celled median mass of mesoderm. x 200

2 Embryo illustrated on plate 32, figure 1. x 300

3 Enlargement of same embryo from photograph made the following day. x 300

Plate 33



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Miastor embryos

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PLATE 34

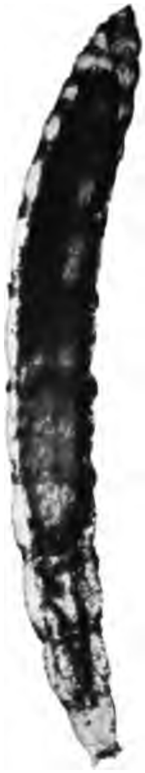
Miastor ? americana Felt

1 Small, yellowish mother larva containing an embryo extending from the fourth to the eleventh body segments and illustrating an early stage in the development of the mesoderm and adipose tissue. x 75

2 Small, somewhat shrunken, yellowish mother larva containing a nearly fully developed embryo, the fuscous anterior portion of the head and the black ocular spot showing distinctly in her posterior (lower) body segments. x 75

3 Portion of a large, white mother larva packed with numerous embryos. The two conspicuous black spots near the middle of lighter areas represent well developed ocular spots of embryos nearly ready to escape. This mother larva contained about 10 such embryos, the heads of three at least, being included in the portion illustrated. x 200

Plate 34



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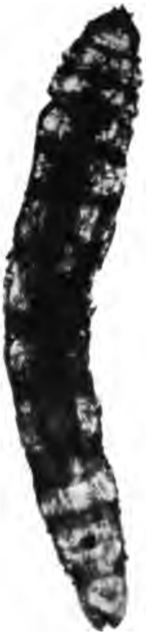

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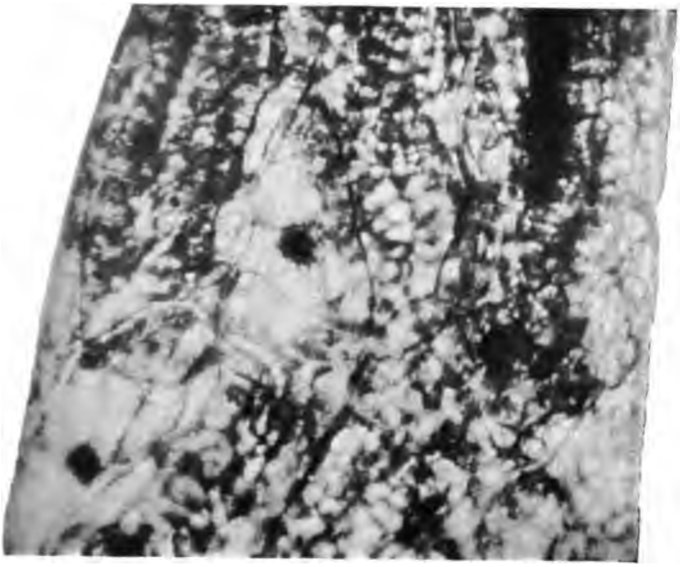

3
Miastor embryos

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PLATE 35

Miastor ? americana Felt

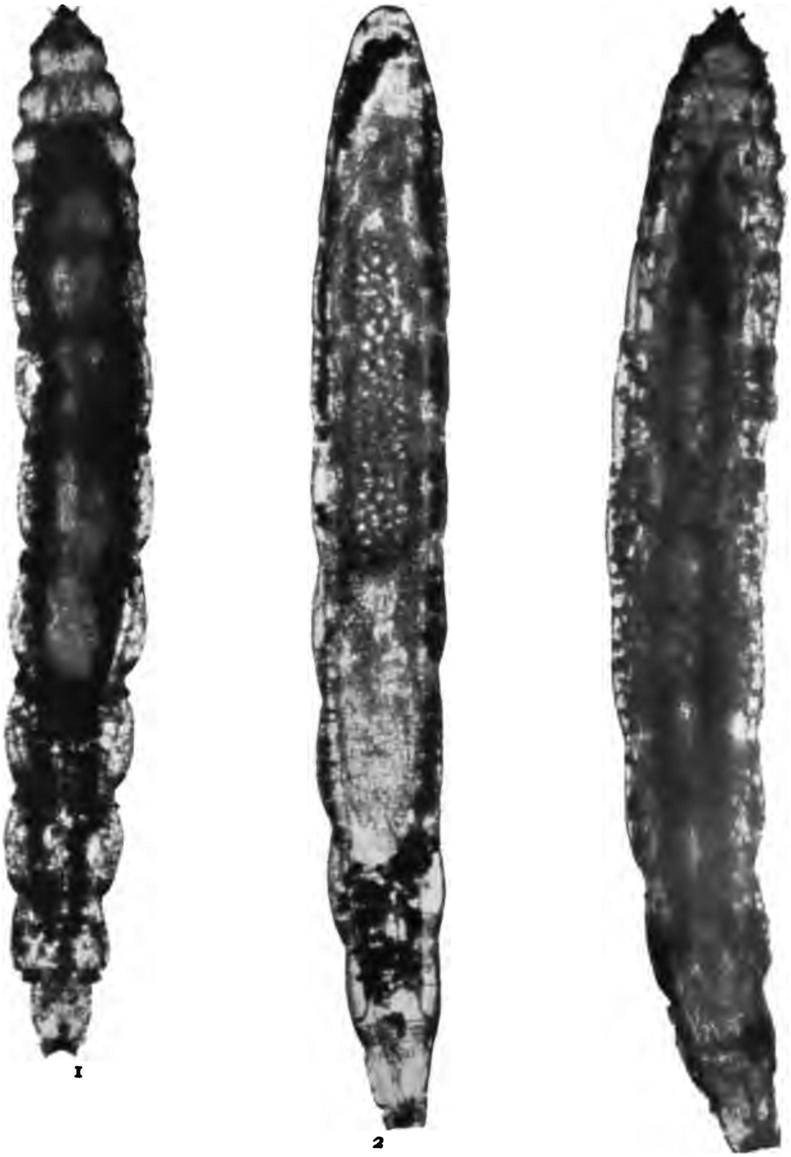
1 Mother larva containing an embryo extending from about the fifth to the tenth body segments and showing an early stage in the development of the mesodermal tissue. x 100. A portion of the latter more enlarged as illustrated on plate 33, figure 1.

2 Small, yellow mother larva containing an embryo extending from the fourth to the twelfth segments and showing in the posterior part of the embryo a conspicuous mass of large-celled mesodermal tissue with distinctly rounded extremities. x 100

3 Small, yellow mother larva containing a nearly developed embryo showing the three-rowed condition due to an increase in the embryonic adipose tissue and a correlated decrease in the mesoderm. x 100

All on this plate are arranged with the head of the mother larva up, the anterior extremity of the embryo being toward the bottom of the plate.

Plate 35



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Miastor embryos

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HAUPTGEWERBESCHULE AT HAMBURG

REPORT ON THE INDUSTRIAL SCHOOLS OF HAMBURG AND ALTONA

WITH REFERENCES TO HARBURG AND BLANKANESE

BY

Harry B. Smith

ALBANY
UNIVERSITY OF THE STATE OF NEW YORK
1911

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Three or four years ago a young man who said he was superintendent of the schools at Waterloo, N. Y., introduced himself to me upon a New York Central Railway train, and said he had taken the train in order to talk with me about his ambition to increase his knowledge of educational work bearing upon industries. He very soon convinced me that he already had considerable knowledge in that line, but he wanted to go to Europe and study the public sentiment, the plans of organizing and methods of procedure, the details of equipment, and all the ins and outs of what was being done to develop more efficient workmen and thereby add to the balance and strength of nations, as well as to the happiness of people. He interested me very much. He desired my help to secure an appointment which would the better enable him to realize his thought. I gave him such aid as I could, and subsequently discussed the subject with him at length on two or three occasions. As a result, he gave up his work at Waterloo and spent a year in as thorough an inquiry into the whole matter as has probably been made by any American teacher. He not only spent months in Europe, but he went on to Asia and around the world. From time to time he wrote me of his progress, and I made suggestions to him as to his further doings.

This bulletin portrays the result of his studies in one of the great cities of Germany and one of the great commercial centers of the world. There he gained very exact knowledge of a subject which is much confused in the minds of American teachers, and he tells of what he saw in a way that will well repay reading by any who are really interested.

The general subject has been for many years much under discussion in this State, and I approve the publication of this paper in the hope that teachers into whose hands it shall fall will read it from beginning to end with some care, for I think they will be benefited by doing so.

A. S. DRAPER
Commissioner of Education

Albany, New York
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HARRY B. SMITH

INTRODUCTION

The object of this report is to give as simply and concisely as possible a sketch of the organization and general working of the industrial continuation schools of Hamburg and Altona, touching to some considerable extent upon those minor details that are contributing to their success, but are not usually dealt with in broader and more philosophical reports on German education. No effort will be made to approach this problem from its psychological standpoint or to present any deep, economic principles. Except for a brief history of the foundation of these schools and references to the interrelation between trade schools and trade-unions or boards of trade, the body of the report deals almost exclusively with the everyday internal workings of the schools, having always in view those points that should be most useful to similar schools in the United States.

The information is drawn at first hand from a residence of seven months in Hamburg and Altona, during which time the writer took three courses as a student in the industrial schools and visited a thousand classes here and in other parts of Prussia. One of the most valuable courses was that given by Director Weckwerk of the hauptgewerbeschule, Hamburg, in which the students were teachers in the public schools and were learning the practical pedagogy of trade school education with a view to becoming industrial teachers.

Of the classes visited, 379 presented one or more points worthy of a place in the notes. Other sources of information were consultations with Inspector Kasten of the Hamburg schools, Director Trenkner of the Altona gewerbeschule, a course in the application of bookkeeping to various trades by Director Trenkner, visits and talks with the directors of the various other schools and with special teachers in the different classes of trade schools, a series of visits made in company with the visiting committee of the Altona butchers trade-union and a similar series in Hamburg with Inspector Kasten and a committee of the trade school board. Information was also obtained by attendance at local public meetings for the consideration of educational improvement, attendance at the Leipzig commercial school conference and finally visits and questions to teachers, employers, workmen, apprentices and others interested in the work of industrial education.

Special acknowledgment should be made to the following gentlemen, not only for their unfailing courtesy, but for their time and advice, which were given freely both in a series of class visits and in private interviews: Inspector A. Kasten, Hamburg; Director Dr Prof. Borbein, realgymnasium, Altona; Director Trenkner, Altona; Director Weckwerk, Hamburg; Director Smarje, kaufmannischeschule, Altona; Director Mittlesdorf, kunstgewerbeschule, Altona; Herr Knobloch, mechanical drawing, Altona; Herr Mayer, decorative painter, Hamburg.

Acknowledgment is also due Schulrat Wagner of Altona for kindness in obtaining permission for special visitations and to Frau H. Kramer of Altona and Frau Paula Oakes of Hamburg for their assistance in the study of schools for girls. Thanks are also due the members of Director Trenkner's class for teachers because of their kindness in arranging visits to their classrooms and for furnishing notebooks, courses of study and samples of students' work when desired. Prof. Dr Schüth of Altona was of great assistance in translation from German into English and the teachers in the public schools and continuation schools in Hamburg and Altona were unfailingly courteous and helpful and ready to render any service in their power. Because of the helpfulness and extreme kindness of all these connected with the school systems of these two cities, and because these cities are geographically one, but politically different, this location proved to be one of the most favorable in all Germany for a study of the various phases of trade continuation school problems.

HISTORICAL SKETCH

Hamburg and Altona, while forming one city of over a million inhabitants, are really two cities with two distinct systems of schools. Hamburg is a free city with powers almost republican and its social and economical conditions are more like those of the United States than those of Altona, which is in Prussia and therefore subject to the central educational government at Berlin. The history, however, of all trade continuation schools in Germany is much the same and that of the Hamburg schools is fairly typical of those in Altona and the other cities of Prussia.

The Hamburg continuation schools began with a Sunday school, meeting for four hours Sunday forenoons to continue the general education of pupils leaving the common school before completing the work of these schools. This school gradually extended into a night school, and the number of evenings and number of hours per evening increased until there were various classes from 5 to 9 p. m. six evenings in the week, in addition to the Sunday morning classes. The growth of these classes and the gradual introduction of specific instruction and separate divisions for the different trades extended the schools into day schools, not only to provide more hours of teaching, but because the popularity of this instruction had increased so much that masters were willing to allow their apprentices certain hours of the day for school purposes.

Parallel with this instruction, which was largely theoretical, or at most semitechnical, arose trade-union schools supported by the masters and devoted to strictly technical instruction in one particular trade. Financial support from the city and a most advantageous arrangement of program induced many of these schools to combine with the general continuation schools to form a system wherein the apprentice received his technical training under the master in the trade-union school, going at the same time to the regular continuation school for general and theoretical education. The outcome of this arrangement was twofold — it cemented the union of trade schools and continuation schools into a system in which the influence of the teacher was extended into the trade school and the practical advice of the trade-union committee was important in directing the course of education in the public continuation school; it also .gave impetus to practical handwork in the general school and hastened the increase of shops, studios and laboratories under direction of the regular school teachers. This trend toward handwork education made technical features necessary in the common continuation schools, and this in turn has resulted in a faculty of professional teachers and professional craftsmen working side by side for the advancement of the student and the betterment of one another.

The continuation school of today is therefore a day school, evening school and Sunday school, a school of general classes taught by common school teachers, of semitechnical classes taught by professional teachers with a special technical education, and of technical classes, shops and allied schools under the direction of strictly practical men. It is a school whose graduates are going out demanding more education and calling into being a technical middle school and head trade school for the instruction of journeymen, who in turn have demanded the master courses set by the Chamber of Commerce, until there is a connected chain from the elementary apprentice class to the master's examination and from the entering class of the trade school to the technical high school, which is really a university and owes its origin to other influences.

SUPERVISION AND GOVERNMENT

These modern continuation schools of Altona and Hamburg, while developing practically the same principles of education, have grown up under two very different systems of supervision and government. In Hamburg, attendance upon such schools is voluntary and the system is entirely local; in Altona, attendance is compulsory and the schools are units in the great Prussian educational system. The city of Hamburg has a special elective board of trade school education which was formerly a branch of the general school board, but has grown more and more independent as the continuation schools grew in number and the powers and duties of this board increased. Today they have the same president as the general school board, but are otherwise independent, except that these two boards must work in harmony because in many cases the same teachers are employed in both schools, the same buildings are in use for day and evening classes and a misunderstanding between the boards would be fatal to both systems. Because of this close interrelationship and because the principal of a building during the regular session is not always the same man as the principal of that building when in use by the evening school and under the direction of a different board, it would be better for the city and more conducive to harmony among all teachers if these continuation schools that have not a separate building and a director devoted exclusively to their work were placed under the same board as the regular schools but with a separate subcommittee. This would be more satisfactory to the directors and to most of the teachers, but the committee, having advanced the schools to such perfection, naturally desires to retain its independence.

The industrial school board is divided into subcommittees for trade schools, commercial schools, technical middle schools, and others. Directly under these subcommittees come the supervising and administrative officers. All evening schools of the regular continuation schools and various day classes held in public school buildings are grouped together under an inspector, a strong, efficient industrial school man; he is also the representative of the general continuation schools, and confers with the authorities governing the independent and union schools attached to the regular system. The commercial continuation schools for boys and girls, which are carried on in public school buildings, are also under this inspector, but under a separate subcommittee. The inspector works constantly hand in hand with the director of the head trade school, which handles a majority of the day classes and shop or laboratory instruction. The director of this school reports to the same subcommittee on trade schools. These two officers therefore divide between them practically all the supervision of elementary continuation schools.

Each of the various other schools of the middle technical grade has its special director reporting to his subcommittee and each school of the elementary grade has its own director reporting to the inspector, or head director. In addition to the above, each class of schools has a regularly elected advisory committee of business men, who visit the schools, advise as to courses of study, look after attendance and the relations between the schools and the employers of apprentices.

Passing over into Altona we find a very complete system reaching back to Berlin. At the head stands the Ministry of Commerce and Trade under which comes the State Bureau of Trades in six divisions — trade, business, continuation and trade schools, skilled work and fine arts, textile trades, and commerce. Under the third section of the bureau comes the regierungs president for that division of the province of Schleswig-Holstein in which Altona lies, the city magistrat and the director of trade schools, the two latter being considered city officials. The commercial schools are under a separate director and these four officials, with a trade school committee of ten men, have the direction of all trade continuation schools. The personnel of the committee is as follows: 1 magistrat, a city official; 1 schulrat, a provincial school officer; 1 director, a city official; 3 city deputies, political officers; 3 citizens; 1 representative from the Ministry of Commerce and Trade This committee is for the entire continuation school system of Altona and meets whenever necessary.

DIVISION OF TRADE SCHOOLS

The division of trade schools in Altona is very simple. All trade continuation schools are classified as gewerbeschulen and are under one director; the commercial classes are all in one public school building and under a separate director, who is also director of the same school building in the daytime, when it is used as a middle school. The artistic trades are in their separate building, the kunstgewerbeschule, with day and evening classes under a competent director and the highest work is done in the machinenbauschule and navigationschule, which are advanced types of technical schools directly under the central government.

In Hamburg, however, the division is more complicated because of the size of the city and the voluntary nature of school attendance. At the bottom of the ladder stand the trade and continuation schools for apprentices and journeymen, divided into a vorschule for unprepared students, handwerkergewerbeschule for trades, kaufmannischegewerbeschule for commercial subjects, fachschulen for single trades or single apprentices, and haushaltungschule for the household industries. The vorschule is not subdivided, but the handwerkergewerbeschule is again divided into gewerbeschule for evening and theoretical work, hauptgewerbeschule for day and laboratory work, tagesgewerbeschule, an advanced step of the hauptgewerbeschule, as is also the wagenbauschule, and finally the weibliche handelsbfleisseneschule, or commercial schools for girls. These schools are laid out to carry on work for three or four half-year terms. One step in advance come the technical middle schools for journeymen doing lower grades of technical work. These schools have a two-year course and produce the noncommissioned officers for the technical army. They are the baugewerkschule for masons, bricklayers, carpenters, iron contractors, contractor and builders, excavators etc.; the technikum with special departments for machine building, shipbuilding, electrotechnics, ships machinery, ships engineering and marine machinery building.

On a plane with these schools, but of a very different nature, is the kunstgewerbeschule for the finer arts and decoration, and above all stands the master course issued by the Hamburg Chamber of Commerce and conducted under its direction, in twenty separate divisions, leading to a theoretical and practical examination without which no master's license will be granted.

BUILDINGS

The housing of all the schools, the provision for shops and laboratories at minimum expense and the dovetailing of industrial and common school classes in the same building has been accomplished in Hamburg and Altona in a simple and practical manner.

The attitude of the school authorities in Hamburg regarding buildings is the same as their attitude regarding shops, laboratories and equipment. They attempt to use the least possible space at minimum cost without being niggardly and to utilize anything and everything in the shape of room that comes to their hands. New space is fitted at once into simple and practical shape and the schools are allowed to grow as needed; no effort is made to force a large number of improvements upon the people at once or to build and equip expensive and elaborate schools or laboratories. Many good points can be learned from noting the skill with which they have seized upon some old abandoned building and turned it into a series of workshops for busy and enthusiastic workers. In all Hamburg there is only one building of any size that is devoted exclusively to industrial education, and no building devoted entirely to the ordinary continuation schools. The building referred to is the hauptgewerbeschule, a substantial three-story brick building in the center of the city, well, but by no means lavishly, fitted up and not to be compared with many of our educational palaces. In this building are housed the head trade school, the building trades school, the technikum, the machine-building school and the school for the finer arts, each with its own director and specially allotted space. There are also several branches of the head trade school that are located in outlying buildings, the most important being at Berliner Thor, where two one and a half-story plain cement buildings, heated by stoves, have been erected and equipped as drawing rooms, workshops and classrooms. A very ordinary three-story private house has also been fitted out as a branch school and is in use by certain of the single trade classes, mostly as workshops, and the upper floor of one of the trade-union buildings has been divided off into workshops for the glaziers, which is one of the single trade schools affiliated with the general trade system. The practical school for barbers, a similarly affiliated school, is held in the gymnasium of one of the public day schools and the ingenuity and simplicity of its equipment will be considered in some detail under " Shops."

Certain special advanced classes in the gewerbeschule and classes of ordinary teachers attending lectures upon industrial pedagogy meet in classrooms provided on the top floor of an army office building in the barracks compound and part of a private house has been fitted up as an evening school for lady hairdressers, and still another as a school for milkboys. In a similar manner, a number of semipublic trade classes are located in various parts of the city and the remainder of the work is carried on in the regular public school buildings when not in use by the day schools. Of these buildings, one is used as the hauptgewerbeschule for evening and Sunday schools with ten branches, nine in common school buildings in various parts of the city and one in part of the new normal school. As far as possible these schools have the same principal for day and evening classes, or a day school teacher in that building as director of its night school; but in some instances there are two distinct sets of teachers as well as students, each set responsible to a different board and working for a different ideal but using the same building, desks, equipment etc. with surprisingly little friction.

This is also true of the schools in Altona, especially the commercial schools, but a majority of the trade school classes, both day and evening, are held in the gewerbeschule, a former public school building, which is now devoted entirely to the continuation schools. The kunstgewerbeschule in Altona also has its own building, the old Sunday school building, but there is good evidence of the spirit of utilizing anything in sight. One of the buildings now used for the overflow continuation school classes was originally a row of cheap two-story brick dwellings which had been made over later into offices for the waterworks and finally passed on to the schools. Several rooms of the government machine building school have been allotted to the kunstgewerbeschule for the use of its stonecutters, lithographers, engravers and printers, and an abandoned church has been secured by the same school and turned to most excellent use. The lower floor of this church has been divided by board partitions into rooms of various shapes and sizes corresponding to dining rooms, bedrooms, reception rooms, and offices.

These are painted, papered, decorated and even frescoed by the students in accordance with certain color schemes laid down by the master to fit each style of room. The upper floor is left as one large auditorium, gable-roofed and with heavy beam work on one end. This is divided into sections by lines on the wall and decorated with all the various designs of ceiling decoration, corner patterns, wall and window designs used in the more pretentious private and public buildings. One set of decorations is immediately removed to make room for the next and class after class has devoted to practise upon this old building time, money and skill that would have been worth thousands of dollars in the general run of trade. Here is a real laboratory, a true workshop in a building that most American villages would consider out of the question for school purposes, where the pupils prepare their work at common wooden tables, climb ordinary carpenters' ladders, work on rough plank scaffolds, and eat their lunches sitting on boxes or wood-bottomed chairs drawn up to a wrought-iron heater.

LABORATORIES AND WORKSHOPS

There are of course several excellently fitted out laboratories and workshops in Hamburg and Altona, but this church workshop is typical of the spirit of industry that makes equipment a secondary consideration. In France, Austria, Belgium, Holland and to some extent in other countries, regular workshops, completely fitted out for teaching the handwork entire, are attached to the ordinary continuation schools, which are not really continuation schools, as that term is used in Germany, but industrial schools occupying the entire time of the pupils and substituted for the ordinary public schools. Many such schools are devoted to the theory and practice of a single trade and turn out journeymen who have served no other apprenticeship.

The city of Munich has connected with each trade school a workshop much on this plan and finds it of particular advantage where the apprentice is on piecework in the regular shop or factory, and must depend upon the handwork in school to give him a well-rounded technical education. It adds very materially, however, to the cost of the school, more than doubles the cost of teaching and makes it much more difficult to find successful teachers. The artisans are mostly opposed to it in Germany because they fear, unnecessarily, the introduction of the French system and believe the apprentices learn better in the regular shop, at the same time furnishing increased available labor to the master.

The general principle of German industrial education is to have the trade school supplement the regular shop, giving what the shop can not give and not usurping the actual shop instruction. This is the principle of Hamburg and Altona, and the object is ever to utilize the practical knowledge the apprentices gain and not to duplicate this instruction in the school. There is, however, a decided leaning toward the other system in the matter of workshops for the artistic trades, painter, decorator, tapestry designer etc., and in the allied monotechnic union school. Of the first mentioned, the shops at Berliner Thor are the most interesting and most complete. These concrete buildings, which have been mentioned before, are fitted out with the plainest and most useful tables and benches, ordinary wall cupboards for models and paints, sets of plain, narrow drawers for storing drawings, unpainted stands, easels, and drawing boards. Here the pupils are given the principles of mechanical and free-hand drawing followed by color scheme work, the application of this to actual decoration and design, conventionalizing, stenciling, wall paper making and imitation, imitation of oilcloth, tile and stone on paper, imitation of marbles and wood on oilcloth, stained glass windows on paper, graining, curtain making, upholstery and tapestry design, drapery and similar work under the supervision of experts. There are also a few strictly mechanical shops, or more correctly, laboratories, as the work is done with models and not with full-sized materials. Altona has two of these, one for masons and bricklayers and one for carpenters and builders. Hamburg has the same and, in addition, accommodates street pavement layers, gutter workers, stone setters, clay and plaster workers.

The Altona shops are located in two small rooms in the cellar of the trade school and are directed by practical men. The masons and builders, after completing the course in drawing, will sketch in the rough whatever is to be built: walls, bridges, domes, arches, ceilings, columns, various methods of wall joining, buttresses and chimney work and other essentials. When these have been approved they are drawn to scale for building. With these drawings the apprentice descends to the laboratory and with miniature bricks and stones proceeds actually to construct models of the same. A heavy square board serves as foundation, and he uses mortar and plaster and cuts the bricks and stones exactly as in actual masonry. Wooden scaffolding is built up for central dome work exactly and to the scale drawing as in regular construction; upon this are laid the stones or bricks, the scaffolding is removed and tests are made of the building's stability. A practical sketch in color is made of the completed work and the model is torn down to make room for the next. The carpenters and builders follow precisely the same plan. The scale drawing of window, roof, house or church is used in the workshop for the construction and erection of every individual beam and brace that would enter into the construction of a full-sized building. The best of these models are often preserved and become the permanent stock of the department.

Either of the above courses, with its allied theory, occupies three years, but there are also courses of three half-years, such as the one for street pavement layers. This course is also based upon drawing, a finished scale sketch being made of every new subject. The smallest details are considered, together with the general principles, and we find lessons on the various methods of joining at corners, side streets entering a main street, streets crossing at right angles, streets entering or crossing at other angles, not only carefully drawn to show the proper relations between the various rows of bricks, but between each individual brick at corners or along angular joints. The students are set to find small defects in drawing as, for instance, where the corners of more than three stones come together in one joint, or where the lengths of the stones on a side street entering at an angle has not been correctly increased to form a rightangular crossing along the main street. They are taught circular and oval construction for parking, gutter work, street car track construction, sewer crossings and are given the reasons underlying every phase of the subject. Thus they are taught that wagons do more damage to pavements when moving on a turn than when moving straight ahead. These drawings are then used as the basis of laboratory work with miniature paving blocks which are cut, rounded and set exactly as in the regular work.

While this work is eminently practical, it differs from the monotechnic trade shops in that the work done there is actual work and may be placed on the market with the product of regular shops. Of these schools the most important in Hamburg and Altona are those for glaziers, barbers, bakers, upholsterers, painters and bookbinders. The writer has a book bound in black morocco leather lettered in gold by hand, a product of the Altona bookbinders school shop, and he was shaved in a very creditable manner in the barbers practice school.

As has been said before, this barbers school is held in the gymnasium of a girls public school. Three teachers, practical barbers, are employed from 5 to 7 each evening to give instruction in shaving and hair cutting, and a large number of poor children, laborers and others desiring a free shave or hair cut, present themselves as laboratory material. So numerous are these that many are turned away each evening at 7 o'clock unattended to, and yet a large class of busy apprentices have been working two hours in an attempt to serve every customer. Promptly at 5 o'clock the hall is cleared of its gymnasium apparatus which the apprentices push back into regular places against the wall. Simple, unpainted, long wooden benches, with folding legs, are then set up in two parallel rows. From a wooden cupboard in one corner, the tools and aprons are brought out, the patrons are admitted, seated at regular intervals on the benches, and three teachers take their places between the rows where they can walk up and down watching and directing the work of every pupil. The master gives the signal. There is snipping of shears and school has opened. Shaving, hair cutting, mustache and beard trimming and dressing is the course for the first year; the pupil furnishes his own apron, shears and razor, but all the other utensils are owned by the school. At the close of the lesson the pupils put away the utensils and benches, the floor is swept, folding tables are set up and the first class gives way to the second, the wig makers and hair workers, who meet from 7 to 9 under the direction of four or five experts. Those who have completed the second year, including switch work and hairdressing, are also present from 7 to 9 learning hair singeing, fancy hair and mustache dressing. The work in wig making is preceded by a special course in drawing. The general principles of wig making are first worked out on the blackboard before the class, and then applied to a particular wig by the students. Each student finally makes a scale drawing on the cloth, cuts this out as a basis for the wig and, using a dummy head furnished by the school and hair paid for by the pupil, proceeds to construct a marketable wig, working under the direction of a teacher. At 9 o'clock everything is returned to its place; when the hall is left it is ready for the gymnastic work of the morrow. These pupils come one night a week to the trade-union shop and visit the regular continuation school two hours per week for theory; there are 172 of them and the total cost is about $800 per year, or $4.65 per apprentice, divided between tuition, city and trade-union — not a serious financial burden.

Besides this apprentice school, there are three other special schools for barbers, one for journeymen and masters in woman's hairdressing, one for wig making only, each supported by its special union, and finally a school for master barbers, a three-year course, which can not be attended until after three years' experience in a general trade.

One other workshop which has come into existence because the introduction of piecework has narrowed the growth of the apprentice, will serve to illustrate the teaching of a purely mechanical trade. This is the trade school for glaziers, whose home is an old house. The theoretical work — German, bookkeeping, drawing and trade drawing, citizenship and tradescraft — are taught in the public continuation school, and the cutting and setting of glass to any measure or design, setting in lead, fancy windows, picture framing and designing for picture or window work, are taught in the shop. Professional teachers in the school teach the names of woods, uses, polishing, importation and buying, durability and adaptability (bending, etc.), names of glass, manufacture, selection, names of color, buying glass and stained glass window designing. The practical teacher in the shop applies this knowledge as soon as it is usable. First, a measurement is made to fill an order, then a design is drawn, a pattern is cut, a completed drawing of the window is made using this design, it is colored, glass is selected and cut, the glass is then set in lead, being laid exactly over the corresponding part of the drawing, piece by piece, until the whole is completed. This is then taken into the framing room and framed; the stained glass window is complete. This work has been done in three rooms on the top floor of an old house, fitted with plain benches, glass racks and tool chests; inexpensive homemade apparatus and frames are used both in glass and woodworking and a lead grooving and cutting machine is the only purchased machinery in the school.

MODELS AND APPARATUS

It is certainly evident by this time that these schools are not given to large quantities of expensive apparatus. The benches, tables, chairs, cupboards and general furnishings of the glazier school are of the plainest and most practical patterns like those described in the laboratories of Berliner Thor, and the models and tools are very generally furnished by the students themselves. Models for such classes as shipbuilders are bought from special firms or are made by experts after drawings furnished by the teachers, and the drawing models for certain free-hand work, stuffed birds, mounted specimens and skeletons, stencils, wire plant-forms, pressed and waxed plants, are purchased from regular supply houses. These, however, are but a small part of the entire collection of models, most of which come as presents from the students. Wooden models of roof work, scaffolding, bridge work, towers, houses and churches are made by the pupils and presented to the school. A few apprentices become expert enough to make the finest kind of ship and machine models in their outside shops and present them to the school. One exceptionally bright and ambitious pupil has presented his school with a set of full-sized models for all sorts of plumbing work, pipe joining, spouts, eaves, etc. which he had made working overtime in the shop where he earns his daily bread. Forms in iron and other metal, plaster, clay and wood, paper and papier-maché are turned out easily in the regular school shops whenever desired, and this continual interchange of interest, one shop producing for another, has a material educational value for the school as a whole.

Maps and charts, time and tariff tables, reports and blanks for commercial use are sometimes bought but more often furnished free. Such charts, for example, as the colored charts used by the butchers classes, must be purchased. These charts give all the outlines for the cutting of different animals, names of cuts, examples on cost, expense and waste, division for sale, cost of each piece, calculation of the final reckoning of gain and per cent of gain. On the other hand, material relating to the government industry and large private companies is always obtained free, and books, papers, blanks, drawing boards, and even instruments, are frequently presented to the school by masters, trade-unions, book companies, firms and friends. It is important that these charts, price tables and business forms be accurate and clear and be passed upon by a committee of practical men because they are not generally used in the monotechnic schools, but in the regular continuation school classes.

GENERAL COURSE OF STUDY

In the general course of study are given all the subjects uniformly prescribed for apprentices. It includes German, writing, arithmetic, geometry, algebra, geometrical construction, trigonometry, free-hand drawing, trade drawing for machine builders, locksmiths, plumbers, mechanics, and the building trades, circular drawing and projections, bookkeeping, commercial law and elementary drawing for unprepared boys. Each of these subjects is subdivided and applied directly to the work of the different trades. Thus reading and writing for electricians would deal with the principles and history of electricity, whereas arithmetic for plumbers would apply the fundamental principles to specific examples taken from the plumbing trade. To these subjects would be added various details agreed upon between the school and the trade-union and an effort would be made to have each separate trade in a class by itself.

TRADES REPRESENTED

That it is impossible to have each trade in a class by itself in any but the largest cities, will be easily seen by a glance at the following list of trades represented in the continuation schools of Hamburg and Altona, and at the second list showing the additional trades often found in the artistic trade schools.

The trades represented are: asphalt layer, bandager, barber, hairdresser, woodcarver, cooper and caskmaker, printer, brushmaker, chemical dyer, chemist, electrician, turner, bicycle builder, fine mechanic, optician, gardener, glazier, glass painter, goldsmith and silversmith, jeweler, engraver, bucklemaker, incandescent-film maker, steam fitter, hatmaker, tinker, tinsmith, candymaker, coppersmith, painter, lacquerer, leather worker, lithographer, photographer, photolithographer, machine builder, mason, gas and water plumber, wire drawer, moulder and puddler, modelmaker, musician, pianomaker, tassel and fringe maker, saddler and strapmaker, boatbuilder, plumber, locksmith, blacksmith, tailor, chimney sweep, typemaker, typesetter, shoemaker, sailmaker, stone lithographer, stonecutter, stonemason, wagonbuilder and wheelwright, stuccoer and plasterer, upholsterer, building carpenter, furniture carpenter, cabinetmaker, potter and over setter, watchmaker, dentist, cigarmaker, brass and bronze worker, apprentices in machine shop, furrier, apprentices and journeymen in tapestry factories and gold woodwork factories, besides the vast number of callings represented in the commercial branches, such as butcher, grocer, general merchant, milkman, hotel employee, messenger boy, ferryman, servant, cook, and a hundred other lines of business. In the kunstgewerbeschule are found sculptor, tilemaker, metal chaser, wagon decorator, bookbinder, worker in grilled iron and kindred trades on the borderland between the artisan and the artist.

SCHOOL HOURS AND PROGRAM

Manifestly one of the greatest difficulties in handling students in so many different vocations is to provide a satisfactory daily program. In this one respect, perhaps, more than in any other the school consults the wishes of the union and employers. It is a fundamental principle in continuation school education that the apprentice should attend school partly on his own time, that is, evenings and Sundays, and partly upon time allowed him by his employer. If an employer is sufficiently interested in the education of his apprentices to allow them two or four hours a week for school purposes, he will be equally interested in the school and in assuring himself that the subjects therein given are a sufficient return for the time and money expended. It is easy enough to prepare for the evening and Sunday classes; the greatest concern is to arrange so that pupils will not attend day and evening classes on the same day or crowd the work into one end of the week. It is also easy to arrange for those pupils who attend school all day, but much care and frequent conferences between schoolmen and employers are required to complete a satisfactory school program for apprentices who are working part of the day and evening and attending school as well.

The head trade school is open every day from 8 a. m. to 9 p. m. and from 8.30 to 12.30 Sunday morning. The classes held in public school buildings are from 7 to 9 p. m. with extra classes from 5 to 6 and 6 to 7 in certain branches. In Altona the kunstgewerbeschule is open from 8 to 12 and 2 to 5 except in the short winter months, and from 9 to 12 and 1 to 4; this school is also open evenings from 5 to 7 and from 7 to 9, and Sundays from 8 to 12 o'clock noon. The gewerbeschule holds classes from 7 a. m. to 9 p. m. although the desire of the Prussian minister is to have no classes after 8 o'clock in the evening. The commercial continuation school in Altona has classes Monday, Tuesday, Thursday and Friday from 2 to 5 p. m. and every evening.

The care that is taken to secure the best distribution of classes between these hours largely determines the success of the school. Thus the locksmiths and similar trades attending 8 hours weekly go two evenings from 6 to 8 and Sundays from 8.30 to 12.30, the employers excusing them early two days of the week, but being unwilling to allow more time. The plumbers and allied tradesmen excuse their apprentices one day a week at 3 o'clock rather than break into two days. These pupils are in class from 3 to 7 one day, and Sunday from 8.30 a. m. to 12.30 p. m. Again, younger boy apprentices who naturally grow tired near the close of the day and are unable to stand both day and evening work, are excused to attend school evenings from 5 to 7, and certain workers in a large tapestry factory who are not excused till 6 p. m. attend from 6.15 to 8.15. The nature of the vocation and its business hours must also be taken into account. Thus the carpenters, who work from 7.30 a. m. to 6 p. m. at manual labor, can attend school from 7 to 9, whereas the watchmakers working at a bench, or the bookkeeper and clerk, must be allowed some classes in the daytime. In the same way a messenger boy, who is out of doors all day, should be given more evening classes than a shopboy or hotel boy who remains indoors, and the classes for the hotel boy should be arranged in the morning when there is usually a lull in the business and those of the shopboy, as for instance, grocer or fish handler, should come early in the afternoon when they can best be spared. A milk handler would naturally object to sending his boy in the morning; a caterer would as naturally refuse to send his waiters from 5 to 7 or 7 to 9 in the evening. The butchers in Hamburg objected to Monday, Tuesday and Saturday school for their apprentices, as they are market days, and their wishes were immediately acceded to; the cafe men requested school on Monday, it being their poorest day. Again, the school authorities desired classes for tinkers two days in the week from 5 to 7, but deferred to the wishes of the master tinkers who preferred one day from 3 to 7 because their boys never worked well on the days they were excused early. Not only does the hour and the day enter into consideration, but also the time of year. Thus, the carpenters and masons wished school from 4 to 9 in winter only, when it becomes dark at 4 p. m. The school authorities conceded 12 hours per week in winter and 6 hours per week in summer, but this was not accepted. A large meeting of workers had been called to discuss this subject but the question had not been decided when this report closed. There are a few tradesmen, such as street pavement layers and gardeners, who have nothing to do in the winter and ought to confine their schooling to certain months, but that these are few will be readily seen by the total number of hours devoted to continuation school instruction. There were 1184 hours so spent in winter and 1052 in summer, there being 3447 winter pupils and 2911 in summer.

INTERNAL DIVISIONS AND JOINED CLASSES

In order to provide classes at the various hours necessary and to increase proficiency by classifying students according to their abilities, the classes as far as possible are divided into sections of students showing different degrees of aptitude. Thus the tinsmiths are divided into four classes for theoretical work according to their abilities and previous education, while coppersmiths, watchmakers, etc. set their own pace by the quickness with which they complete their work, and soon divide into a large number of groups. After the first six months the drawing classes are very largely determined by the ability and tastes of the apprentices, while in the upper classes the free-hand drawing is entirely individual, as it is also in such technical drawing as patternmaking except that the same designs are repeated. On the other hand, there are a large number of combined classes, either because there are not sufficient students in one vocation to fill a class or because the work is the same for several different trades. We find a united class of factory workers, railroad men, iron workers, moulders and puddlers, boiler workers, etc. joined for German and arithmetic, joined in the general principles of tradescraft but taught its particular application in separate divisions, and entirely separated for drawing. Glaziers, tapestry workers and upholsterers, wall paper makers, art masons, painters, and others are joined for drawing. The free-hand work from models, mounted specimens, and skins, conventionalizing the same, stencil cutting and general design are taught in common. Transferring this design to wall paper, plaster, glass, cutting in wood or stone, frescoing, curtain tapestry and carpet designing and all such special work is done in separate groups, even smaller than the trade class. The masons and carpenters have arithmetic, German and citizenship together, while masons, stonesetters and pavement layers go still further, having plane, square and cubic measure, measurements of fields and plots, amounts of dirt removed or needed for leveling, grading, dips and terraces, work surrounding irregular areas, ponds, parks, park walks and walls identically the same in all trades. Bakers and butchers have theoretical work in common, but the designing of cakes, candies, imitation fruits, etc. has no value for any trade but that for bakers and must be taught to them alone. In this manner the whole course of study is built up, the classes are joined or divided, and their places in the daily program determined.

COURSE OF STUDY

It should be of particular interest to know exactly what such a finished course of study is like, that is, exactly what, to the smallest details, is considered important in the wider building of apprentices in continuation schools. It would be nearly impossible and certainly useless to give a large number of courses of study; but no better way can be found of gaining a general understanding of the work and ideals pervading a German continuation school than to study carefully a few typical courses of study. For this purpose four courses are presented here: the general six-months course in drawing that precedes and forms the background for all mechanical work; the course laid out in Altona for carpenters, as representative of the ordinary trades; the Hamburg course for decorative painters, as representative of the artistic trade; and a course for grocers, representing the commercial branches. The first of these courses was made out especially for this report by the drawing teacher, Herr Knobloch; the second and third are copies of private courses made for this purpose through the kindness of Director Trenkner and Inspector Kasten, and the last is taken directly from an annual report. The courses, which were all in German and contained many technical words and expressions, have been translated rather to give the reader a clear and definite idea of the aim of the whole instruction than to offer a course for adoption or an English translation of German mechanical terms.

PRELIMINARY COURSE FOR BOYS

Circle drawing. The subjects of Lachner's first book and in addition direct and oblique projection of a few other bodies and a few joined bodies. Free-hand drawing. Drawing and painting of plants, flowers, fruits, stuffed animals and perspective portrayal of different subjects.

This teaching is both class and individual.

TRADE DRAWING FOR THE BUILDING TRADES

First or elementary step

A Geometrical constructions
  1 Polygon construction
    Pentagon, in circle of given radius upon a given line as a side
    Hexagon, in a circle
    Nine and fifteen-sided figure, in a circle

- Heptagon, in circle of given radius upon given line as a side
- Octagon, in a circle of given radius upon given line as a side

2 The circle (radius, diameter, semicircle, quadrant, secant, chord, tangent, sector and segment)

3 Curves

- The ellipse (length of both axes given; use the four constructions)
- The parabola
- The hyperbola
- The spiral of Archimedes and the Ionic spiral
- The "evolvente"
- The oval
- The cycloid curve
- The characteristic arch curves
  - Semicircle arch
  - Flattened or shallow arch
  - Higher arch
  - Pointed arch
  - High pointed arch
  - Depressed arch (arch under pressure), three constructions
  - Tudor arch or depressed pointed arch, two constructions
  - Arch of one base, two constructions
  - Cornice arch, the donkey-back
  - Round and pointed horseshoe arches

B Gothic measurement forms

1 Fish bladder

- "Passe" or yoke
- Horns

C Divisions of architectural plates and their arrangement according to size and importance

1 Rectilineal

- Small plate, nut, plate, groove, rabbit

2 Curvilinear

- Rivets, bolts, grooves, quarter bolt
- Moulding, grooved ledge, trochilus

D Familiarizing the students with the use of various measurements and units of measure

E Free-hand drawing from models
  1 Frieze, corner pieces, rosettes etc.
  2 Various wood joints
F Technical script, block type with "quellstoft," cork, crayon and brush

Second or middle step

Masons and carpenters have separate instruction

Representative geometrical principles from trade models, avoiding deeper scientific principles and reasonings

A For middle and upper step
  1 Prism, cylinder, pyramid, rule, spindle, conssinet
  2 Combination of the above forms
  3 Intersections of these forms
  4 Truncation
  5 Cross sections
  6 Isometric and axeometric representations
  7 Practical applications and uses
  8 Development of curved stairways
  9 Roof work
  10 Frequent modeling in cardboard
B Division for masons
  1 Measurements of the normal German brick (three-quarters, top piece, quarter, large and small building brick)

NOTE. The following examples should first be laid out or built up by using small model bricks, sketched, and afterwards, when necessary, clean finished drawings made. In the latter process many important points may be brought to the students' notice.

  2 Running layers, binding layers, rounding layers, plain and cross binding or joining, and most important of all, Polish, Hollandish, English and Gothic joining
  3 Finishing off a wall end with three-quarter brick
  4 Finishing off a wall end with binding brick
  5 The right angle wall corner
    Binding with three-quarter brick
    Binding with large and small building brick
  6 A partition wall joined at right angles to a front wall by three-quarter brick and by building brick
  7 Two walls crossing at right angles
  8 The walls join to form an obtuse angle
  9 The walls join to form an acute angle
  10 Pillars — right angled, eight angled, round
    Columns, models and patterns
  11 Chimney building and ventilator work

C Division for carpenters

1 Wood joining

To lengthen a timber, blunt, oblique and obtuse joints, with cramp iron or bracket and splint, with straight blade, hooked blade, oblique blade, ridged blade, direct hooked blade with oblique cut, swallowtail with parapet

Crossing — simple overlaying and cutting

End joining — oblique blade, hooked blade, one-sided swallowtail form blade, swallowtail blade with parapet, oblique tenon, breast mortise

Corner joints — oblique corner blade and hooked binding, horizontal binding at right angles, mortise and tenon, hooked mortise and tenon

Joining of a horizontal beam into one standing obliquely, mortise and tenon, swallowtail with pincer mortise

Joining an oblique lying beam into one perpendicular and one horizontal, the gun mortise

Joining two oblique lying beams, razor mortise and tenon

Dressing of wood

Third or upper step

A Division for masons

1 Facing of tile, quarry stone and broken-stone walls

2 Building of cornices and mantels

3 Frame construction

Building of door and window openings

4 Construction of simple arch and vault work

The Prussian capping, cylindrical vault

Bohemian vault, the cross vault (groined arch)

5 Scaffold work and frame construction

Advance students can be employed with the following:

6 Developing working drawings for simple buildings, stalls, sheds and godowns, outbuildings and additions, workman's houses, etc. from sketches of ground plan, front elevation and cross section

B Division for carpenters

1 Simple and complex roof timbering and reinforcement

2 Simple and complex explosive and mine timbering

3 Simple and complex cranes

4 Beam joining and dovetailing from sketches
5 Representation of wood and iron framework in walls from previously given building drawings
6 Sketching to measure to details of beam construction
7 Roof construction, saddle roof, peak, mortise work, mansard, desk-top roof, Holland roof
8 Simple stairway construction

The instruction is divided into four successive classes as follows: elementary step, class 4, or first school year; middle step, classes 3 and 2, second and third school year; upper step, class 1, fourth school year.

In the winter semester there is six hours instruction weekly, two hours constructive drawing or descriptive geometry, four hours trade drawing, with two hours modeling included.

Many industrious students, in extra classes, take 6 to 8 hours general and trade drawing weekly in addition to the required course, and 6 to 8 hours summer drawing course.

NOTE. In the third and fourth school year two hours per week are set aside for modeling and model making.

COURSE FOR CARPENTER AND JOINER

The carpenters are instructed in three successive classes, first, middle and advanced step, in each of which the necessary parallel classes are organized. The entire course covers four years, and the subjects are as follows: trade science and citizenship, German, arithmetic, geometry, and in middle and upper classes, bookkeeping. From the school time two hours weekly is to be devoted to trade science and citizenship, together with German, and two hours weekly to arithmetic, geometry and bookkeeping. Besides the above, every class must have at least two hours weekly of instruction in drawing.

First or elementary step

A Trade science and citizenship. The instruction in these subjects shall make the student familiar with all his rights and duties as a trade worker, citizen of the city and of the state and shall familiarize him with all tools and working utensils, materials and trade customs. In every class about one-half hour per week is to be devoted to this work, which may be materially advanced by combining it with reading instruction. The main points are as follows:

1 City statutes, school ordinances for trade continuation schools, the labor book, the time of instruction, teaching relations and con-

tracts with trades, social and political history of the legislation of the German Empire, blessings and efficiency of workers' insurance laws, general handling of sick insurance and accident protective orders for woodworkers. Review of the entire subject.

2 General discussion of the carpenter shop. The outfit, lighting, heating, cleaning, general rules of protection against fire and accident, first aid to the injured and other accident assistance. The Samaritan Society and Red Cross.

3 Important points in the teaching of good health from the pamphlet on health and treatment of tuberculosis and alcoholism.

4 The wood. The tree and its parts, trunk, planting and growing of trees, the decay and felling of trees, rafts, gums, transportation. Working the trunk up into whole timber and cut timber, planks, boards, beams, laths and veneer. The woods used by the building and furniture carpenter. The following to be noted especially: pine, kiefer or fir, common red pine or hemlock, white and silver pine, larch pine, yew, pitch pine. Leaved trees: oak, maple, ash, beech, birch, silver birch, elm, chestnut, walnut, pear, linden, alder, poplar, redwood, mahogany, acasia and ebony. The greatest importance in discussing the above is to be laid on the following points: characteristics by which each may be recognized, peculiarities, where grown, trade and transportation, price, physical and chemical property, form and density, pliability for bending and rigidity, wearing qualities, resistance to water, air and fire, color, smell and heating power.

5 Weakness and sickness of wood, external and internal growths, knots, double splint, cuts and fissures, boils, red, white, limb, and ring rot, spots, weathering and wormholes.

6 The wood-injuring insects and other enemies of wood: bugs, beetles, psilura monacha, mushrooms, parasites.

7 Other work material of the carpenter: glue, alcohol, shellac, oil, lacquer and oil colors, stain varnish, sandpaper and other smoothing material, polish, cement, putty, veneer and artistic veneer.

8 The administration of the city of Altona, history, business and trade conditions of the city from the textbooks of Höft Ehlres and Trenkner.

B German

1 Reading. The instruction is based upon the reading book of Schmarje and Trenkner and the Trade Reading Book for Woodworkers. It is the object of this work in reading to advance the following: preparation for intelligent reading, mind and character

building, love of Fatherland and to enliven and enlarge the scope of other branches of instruction, especially tradescraft and citizenship, as before mentioned. In the Schmarje-Trenkner book, selections for the elementary step may be made from the following articles:

a In the province of religious life and custom:
  no. 31 Child thankfulness and ungratefulness
  no. 32 You shall love and obey your parents
  no. 43 If all should come right
  no. 54 For my son
b From nature study:
  no. 56 Wood and its history
  no. 81 The lamp, past and present
  no. 83 Petroleum
c For knowledge of lands and their people, Fatherland and home city:
  no. 64 Joachim Nettelbeck
  no. 24 How Altona was founded
  no. 26 Der schwedenbrant in Altona
d From the work:
  no. 114 Work
e The calling and its standing:
  no. 40 Choosing a trade
  no. 45 The best letter of recommendation
f Handwork, industry and knowledge:
  no. 30 What a good hand workman may become
  no. 93 The handworkers' apprentice
g Trade and exchange:
  no. 42 My first ride on the railway
  no. 107 On the harbor in Hamburg
  no. 108 The Altona fish traffic
h Health and welfare:
  no. 71 The man with the machine
  no. 72 The dwelling of man and the air
  no. 73 About food
  no. 74 Washing and bathing
i The state and statescraft:
  no. 100 Laws for the protection of the German laborer and their effect

From the trade reading book for the building trades the following may be selected:

no. 8 With the different woods
no. 9 The oak and the storm
no. 10 Felling, drying and seasoning and cutting of wood
no. 12 Worm-eaten wood

2 Grammar and spelling instruction

Note. This instruction is to be given at every opportunity in connection with reading and with the preparation and correction of written work. In addition, the following subjects are to be especially drilled

a Inflection of nouns in connection with the three articles of gender, the possessive and demonstrative pronouns and indefinite numerals
b Inflection of nouns with adjectives
c Inflection of personal pronouns
d Practice with prepositions
  (*1*) Accusative
  (*2*) Dative (aus, bei, mit, etc.)
  (*3*) Genitive (während, wegen)
  (*4*) Dative and accusative with and without the meaning of space
e Practice with a few of the most common governing adjectives
f Forming the passive of verbs
g Practice with few important transitive verbs
h Reflexive verbs (sich, with the accusative)
i Practice with impersonal verbs governing the accusative
j Practice with intransitive verbs governing the dative
k Reflexive verbs governing the dative (sicherlauben, etc.)
l Impersonal verbs governing the dative
m Verbs governing the accusative of the thing and dative of the person
n Dass, das zu senden, zusenden, etc.

3 Written work

Every week a corrected and rewritten composition. The work shall include private letter writing, simple business letters and correspondence and the simplest coast, railroad and mercantile formulas according to the following plan:

a Master carpenter G opens a business; write an advertisement circular
b He seeks through the newspaper to hire an apprentice who shall apply in person with his school certificate and a sketch of his life, written by himself; write the advertisement
c The student shall write a sketch of his own life

d The master notifies the trade continuation school and state sick insurance authorities of his employment of this apprentice
e The apprentice writes a letter to his parents
f The master recommends himself to the public through the newspapers
g He seeks a journeyman through newspaper advertisement; the advertisement and the journeyman's letter to the office of the paper
h Journeyman's letter of application
i The master orders wares, material and tools
j The merchant fills out the order:
  (1) bill of lading; (2) accompanying letter; (3) bill
k Answer of the master upon receipt of the goods; letter of acknowledgment
l The master sends the amount of the bill by mail; post and money orders
m The apprentice congratulates his father on his birthday
n Customer A sends order by letter to Master G
o Master answers upon receipt of the order
p Master G sends the wares ordered (see topic *j*)
q The customer acknowledges receipt of the wares
r The apprentice sends washing home; packet post rules
s After long interval he begs for the return of his washing; post card
t Customer B orders by mail
u Master seeks from A information concerning the business standing of B
v Answer of customer A
w Master G fills out the order
x B is not satisfied; he complains
y Master G answers the complaint
z G's demand for payment
aa Answer to the same
bb Second demand for payment
cc B sends part payment
  (1) money order; (2) accompanying letter
dd Receipt for the amount paid
ee B sends the remainder; receipt in full
ff G must move his store; moving-van agent H applies for the job

gg Circular stating the change of business address

hh Master G needs more capital to enlarge his business
  (1) note; (2) security

ii A journeyman leaves his employ
  (1) workbook; (2) recommendation

jj G writes to an employment agency for a new man; post card with attached answer

kk The apprentice has holiday leave and notifies his parents of his coming

ll He writes from home requesting his master to extend his leave

C Arithmetic and geometry

Every mathematics period begins with mental arithmetic. The subjects for work in written arithmetic must relate to the carpenters trade in every possible way and extend to the addition and subtraction of simple and complex numbers, the four fundamental operations in simple, common and decimal fractions, practice in arithmetical rules, easy examples in percentage and interest. The German systems of counting, money, measure and weights, are to be especially emphasized. Every quarter there are to be two class examinations in arithmetic, corrected and rewritten. Lessons on reduced scales of measurement and transferring from one scale to another. Angles and their measurements. The triangle, its various kinds, properties and measurements. Completion of the geometrical construction lessons, 1 to 103. Every quarter two lessons in finished geometrical drawing.

Second or middle step

A Trade science and citizenship

1 Tools and machines in carpenter shopwork. The bench and the bench tools, the ordinary tools and work appliances, the power-supplying machinery, gearing and transmitting machinery and the working machines. Refer in these connections to the division, descriptions, relations, prices, uses, handling and operation and those physical laws which are concerned in their working. Care in the use of tools and operation of machinery, first aid to the injured, accident policies of the woodworkers trades-union are important.

2 Review of the work in materials, first step *d* and *g*. The materials which are used for polishing and beautifying wood surfaces and those used for binding and gluing purposes.

3 The by-products of wood; resin, oil, coal, charcoal burning and other methods of producing charcoal.

4 Divisions of woodworking; planing, graining, staining and coloring, polishing. painting and lacquering, waxing and rubbing, imitations etc. With this also comes the description and the nature and purpose of the above operations.

5 Most complete description of the purpose, efficiency and operation of the different wood joinings, according to the width and length of material. Joining of frames and panels. Corner joints in one plane and in two planes.

6 Short discussion of ornamental forms, their origin and uses. Convex moldings, quarter round, quarter concave, full round, groove, cornice, small plate, plate, the crumpled corner, rosettes and buttons, diamond square, columns and pillars, pillaster, and furniture feet.

7 Discussion of normal measurements for table, chairs, cupboards, etc.

8 Handwork in eariler times, the organization of trades in the neighborhood, and the history of the state's trade ordinances.

9 The laws pertaining to trade insurance and workman's insurance and the regulations concerning trade protection and tradesman's protection.

10 The journeyman's examination, the journeyman, the workman's contract.

11 The government of the kreis (governmental districts) province and state.

B German

1 Reading. From the reading book of Schmarje and Trenkner, the following pieces are for selection:

a In the province of social and religious life:
  no. 29 From "The greeting"
  no. 103 The hole in the sleeve
  no. 112 One man — one word
b From nature study:
  no. 84 Fire and burning
  no. 85 What is a chemical union?
  no. 118 Anthracite coal
  no. 119 Iron

c Countries, people, homeland and native village:
  no. 63 Life in a German city in the middle of the 18th century
  no. 67 War pictures from the year 1813
  no. 132 Emperor Frederick III

d From the work:
  no. 115 The workman's pay
  no. 124 Trade intercourse and partnership

e Calling and position or rank:
  no. 27 Benjamin Franklin to a young friend
  no. 39 John Maynard

f Handwork, industry and skill:
  no. 4 Agriculture and handwork among the old Germans
  no. 17 The handworker tradesman in olden times
  no. 90 The lesson of handwork
  no. 92 Why must the independent handworker learn to keep books?

g Trade and exchange:
  no. 10 Board of Trade
  no. 38 Development of steam navigation
  no. 78 German trade life at the beginning of the 19th century

h Health and welfare:
  no. 75 Bacteria
  no. 77 A false friend

i The state and statescraft:
  no. 100 The laws relating to the protection of the German laborer and their practice
  no. 109 Concerning the state
  no. 110 Rights and duties of the citizen
  no. 70 Trade courts and businessmen's courts
  no. 111 Extracts from history of state trade laws

From the trade reading book for the building trades select:
  no. 7 "Urwaldfrieden"
  no. 13 The house sponge
  no. 43 The cabinetmaker

2 Grammatical and spelling instruction. Review and enlargement on the work for the elementary step; simple punctuation.

3 Written work. A short written lesson once a week. Social letters, business correspondence, various formulas, petitions and requests to governing boards. At this time original compositions and articles relating to specific branches of tradescraft and citizenship may be expected of the student.

The teaching plan for written work is as follows:

a Master carpenter F opens a business. Pupils will write advertisement circulars; notice to the authorities

b He orders wood from a lumber dealer. The order; the addressed envelope

c The lumber dealer accepts the commission. Record of acceptance, answer to the order

d He sends the lumber. Bill of lading with return receipt attached; accompanying letter, items and bill; receipt; freight order

e The carpenter sends money. Letter regarding payment; post money order

f Customer A orders some furniture from the carpenter. Order

g The dealer advises with a business friend concerning A. Letter asking for this information

h The business friend answers. Letter

i The order can not be filled at the appointed time. Letter of apology

j The apprentice is released because of chronic illness. Notice of illness and release sent to the continuation school, to the treasurer for the sick and to the insurance authorities for aged and individuals

k Apprentice D takes up the apprenticeship. Notice to the continuation school, treasurer for the sick and aged and invalids' insurance company. Contract; workbook

l The apprentice sends washing home. Packet post and address

m The goods sent A do not suit. Letter of complaint

n Answer to the same

o Customer B fails to make payment. First and second request for payment; collection by post

p The master moves his business. Circular of notice; summons of furniture mover

q Rent contract

r The master borrows a sum of money to enlarge his business. Note

s Business friend E takes the oath of citizenship. Certificate of citizenship

t The master advertises in the paper for a journeyman

u Journeyman G applies.
Letter of request; personal life history

v He is accepted. Contract

w Apprentice H finishes his apprenticeship and is granted a certificate

x Apprentice H seeks postponement of military service

y Master receives the notification and estimate for income tax. He feels himself rated too high and protests. Tax protest

C Arithmetic and geometry

Mental arithmetic as in the elementary step. More difficult examples based upon the work covered by the elementary step. Complete subject of percentage, interest, merchants' accounting, rebate, discount and firm and corporation accounting. Form of calculations, exact accounting for all costs and their apportionment to various branches of business. Every quarter, two short examinations in reckoning, corrected and recopied. Detailed consideration and reckoning of all four-cornered figures. The regular polygons. Consideration and measurement of cubes, prisms and cylinders. The following problems of the work in construction for the elementary step must be reviewed; nos. 11, 15–18, 23, 24, 41, 48, 50, 69, 70, 72-77, 80, 81 and 95. Complete in addition the problems in construction, 104 to 108 inclusive. Every quarter, two short examinations.

D Bookkeeping. About 30 hours work. Lessons 1 to 12 in the teaching plan of simple bookkeeping, including all the practical examples pertaining to this work.

Third or senior step

A Tradescraft and citizenship

1 Divisions of carpentry

a For building workers: floors, windows, doors, wall panels, ceilings, store fixtures, etc. In the consideration of the above, as well as in the following steps of the carpenter's trade, the art or kinds, the purpose and the manufacture of each, is to be completely described.

b For cabinet makers: tables; art and purpose for which each style is adapted and its particular measurements. Manufacture, peculiarities, divisions, and normal measurements.
c Chairs and seating furniture: kinds, purpose of each, peculiarities, manufacture, divisions and normal measurements.
d Clothespresses, bookcases, etc.: same as *b* and *c*.
e Thorough review of the important paragraphs found in the work of the elementary and middle step.
f The handworkers trade-union.
g In opening, building up and running a business, what special laws must a handworker always take into consideration? From Trenkner's "Business Knowledge."
h Private and governmental methods and suits for the collection of debts. Complaint through the courts. Trade-union's court of arbitration. Trade court. Review of the general subjects of courts and their working.
i Stock companies.
j Coinage — measure, weights, credit and banking.
l The journeyman and master examination.
m Simple political economy.
n Constitution and government of the German Empire. Military duty. War and navy department. Taxes, customs, duties. German colonies.

B German
- 1 Reading. From the reading book of Schmarje and Trenkner the following pieces are to be selected for the senior step
  - *a* From the province of customs and religious life:
    - no. 55 About clothing
    - no. 102 Old Gold
    - no. 104 The blessing of duty
  - *b* From nature study:
    - no. 8 The German forests
    - no. 37 The elasticity of steam
    - no. 79 The telegraph
    - no. 80 The telephone
  - *c* Knowledge of lands and peoples, Fatherland and home:
    - no. 2 Germany
    - no. 25 Germany in the Thirty Years' War
    - no. 59 Conquests of Frederick the Great in the Seven Years' War

- no. 96 Rebuilding the German Empire
- no. 120 Germany and the Hohenzollern
- no. 130 We Germans fear God
- *d* From the province of work:
  - no. 105 About prosperity
- *e* Calling and standing:
  - no. 53 The entrance into business
- *f* Handwork, industry, art and skill:
  - no. 15 Unions and guilds in the middle ages
  - no. 16 Fight of the guilds against the patricians
  - no. 87 The little motor of the trades
  - no. 86 The electric motor as motive power
  - no. 91 Handworkers unions
- *g* Trade and commerce:
  - no. 121 The German colonies
  - no. 123 About money
  - no. 117 Stock companies
- *h* Health and welfare:
  - The care of the dead
  - no. 127 Miss Randers
- *i* State and statescraft:
  - no. 129 Concerning taxes and imposts
  - no. 68 The wonderful order of the states
  - no. 69 The administration of justice
  - no. 98 The state constitution

From the Trade Reading Book for the Building Trades the following selections are to be read:

- no. 11 The wood in interior finishings
- no. 20 The Roman art of building
- no. 22 The Gothic art of building

2 Grammatical and orthographical instruction

Review and enlargement of the work set down for the elementary and middle steps. Punctuation.

3 Written work. A written exercise is to be handed in once a week. Besides smaller original compositions on subjects related to the calling, tradescraft and statescraft, the student is to prepare papers on subjects relating to business, memorials, governing boards, and formulas. He should fill out blanks and prepare papers such as result from the work given in bookkeeping.

C Arithmetic and geometry

Mental arithmetic in every period. Emphasizing and enlarging the work of the elementary and middle steps from the book of Ernst Loose, pages 51 to 69. Reckoning of costs, same text, pages 123 to 142. Every quarter, two complete compositions corrected. Repetition of the lessons in constructive geometry given in the elementary step, and from the middle step, exercises 108, 124, 148, 154 and 162. Complete the work from 169 to 211. Repeat and complete the work on plane measurements and the measurements of solids. Every quarter, two exercises completed and corrected.

D Bookkeeping

Review the work of the middle step. Complete lessons 13 to 18 of the teaching plan for single entry bookkeeping. The exercises on the booking of various business transactions as given in the carpenters' teaching plan, laid out by Director Trenkner.

COURSE FOR BUILDING CARPENTERS

A Elementary step

The elementary step for building carpenters is exactly the same as that for general carpenters and cabinetmakers.

B Middle step

The building carpenter has the same instruction in projection as the cabinetmaker and the following work in addition is to receive special stress. The most important wood joints, axeometrically and isometrically projected. Profiles of mantels, cornices, shelves, door jams, doorcases, doorcase tops, thresholds, window jams and window seats, paneling and wainscoting, corner joints and various parts of plans for windows and doors in front elevation, ground plan and side elevation. Ornamentation and coloring as in the other classes.

C Upper step

Details of doors and windows, isometrically projected. Details of natural wood and open beam ceilings, isometrically projected. Drawings of various room doors, cross section and scaled. Measurements of sliding doors, cross door, panel door with stop, six-panel door with stop. Double doors and house doors. Simple and double window construction, ornaments and coloring.

COURSES FOR ARTISTIC PAINTERS

In the spring of 1903 an agreement was made between the painter and lacquerer trade-union and the school authorities for the establishment of trade classes for these apprentices. On every week day of the winter months the apprentices were bound to attend school from 4 to 7 or 9 p. m., as directed. Under these conditions the classes were started in January 1904. It was soon apparent that good work by the decorative painters could be done only by daylight. In 1906 the former agreement was changed so that the union bound itself to send these boys for two full days in every week from 8 a. m. to 12 m. and from 2 to 7 p. m. from October 15th to February 28th in every year. The tuition for this half year was $5, including free paint boards, easels and colors.

The following plan is for this 18 hours of work:

The first year: 2 hours business correspondence — for week students, 3 hours; 2 to 3 hours arithmetic; 2 hours penmanship; 3 hours linear drawing, and 9 hours free-hand drawing.

The second year: 2 to 3 hours business correspondence; 2 to 3 hours arithmetic; of the 12 or 14 hours left over, one-half is to be devoted to decorative painting and one-quarter each to free-hand drawing and wood painting.

The third year: 2 hours tradescraft and citizenship; 2 hours surface measurements and price reckoning; the remaining time divided as in the second year.

The fourth year: 2 hours bookkeeping; 2 hours business law and citizenship; of the remaining 14 hours, one-third for wood and marble painting and two-thirds for decorative painting. Students completing the work in three years are given in the third year 3 hours tradescraft and citizenship, 3 hours calculation and bookkeeping, and 12 hours divided as in the fourth year.

The lacquerer apprentices must attend school two afternoons each week from 1 to 7. They take part in the theoretical instruction given the painters' apprentices. In the last three years the lacquerers are divided into special trade classes, one-half time being devoted to trade instruction, one-quarter to free-hand drawing and one-quarter to wood painting.

Glass sign painters and similar apprentices who are taught with the decorative painters, will have the work always related and referred to their special lines. Lettering and special firm painting are optional in the evening. There is also free optional instruction in free-hand drawing, arithmetic and German from 7 to 9 p. m.

The detailed course of study is as follows:

First year

A Business correspondence. Strengthening and grounding in German. Instruction in ordinary business lettering, sign writing and other inscriptions. Frequent review of the prepositions and similar grammatical points by constant reference to the most frequent mistakes. Punctuation, exclamation point and hyphen. Post and freight business, money, accounting, receipt, demand for payment. Ordinary goods, bill of sale, inquiry anent buying. Even the simplest work of these apprentices is full of mistakes in German and grammar; nevertheless, it is not recommended that the grammatical instruction, as such, be put to the front, but examples are to be chosen so that this instruction comes in conspicuously before the student and makes him feel the need of it.

B Trade reckoning. Whole numbers and decimal fractions, coinage, mass, weight, time. Receipts and expenditures, cost of living (dwelling, clothes, food, incidentals). Income, by the hour, day, week, month and year. Laws of workman's insurance. Reckoning profit for given length of time. The student personally is to be made the main point considered and all reckoning is to be related to him and his trade. Selections from Friedman's arithmetic.

C Penmanship. The elements of penmanship and letters; their union into words. Advanced students in penmanship in words and sentences may take up the Gothic letters, practising with pen, together with signs and business inscription.

D Lineal drawing. The most important geometrical constructions, right-angular and circular divisions, ellipse construction and the relation of these to ceiling and wall divisions. The use of splints is absolutely forbidden.

E Free-hand drawing. Drawing from plane surface models, pressed leaves, butterflies etc. Conventionalizing nature studies. Use of conventionalized form to complete simple filling patterns and friezes. Cutting the stencils for these patterns, use of the same in stenciling wall patterns, papers and friezes. In all nature studies the largest scale possible is to be used, strong outlines, clearly defined ribs and nerves in leaves and flowers, sharp definition between different colors so that the arrangement in a stencil, the building of openings, and holding strips become as simple as possible. When possible, the apprentice should work with only one color, effecting color scheme by using tone paper or one-color tapestry as the background. Later, drawing from rolled, curved or drooping leaves from wire models; studies in cuttings and living plants, dry and wax preparations.

Second year

A Business correspondence. Important points in the laws of trade. Duties of apprentices. Journeyman examination. Duties of the journeyman. Seeking positions and applications. Memorials to governing boards. Biography. Advertising circulars, opening of business, rejection of goods, lawful demand for payment and order for payment.

B Business arithmetic. Common and decimal fractions in computations. Interest, profit and loss calculations, rebates, divisions and partnerships and stock companies accounts.

C Decorative painting. Practice in drawing light and heavy lines and bands. Outlining walls and ceilings with simple lines, giving the wall and ceiling tones. Drawing simple cornices, mantels, outlined in geometrical motive. Stencil friezes from geometrical or simple plant motives in one-color tone either upon the ceiling or wall color tone. At all times, color practice from a given wall paper or tapestry or from some color assigned by the teacher. Practice in the selection of tones for lines and friezes. Color sketches that contain a finished design are first to be made in a scale of one-twentieth to one-tenth, then carried out in natural size. Stencils in charcoal drawing, tracing and cutting. Lessons: kitchen, roof, cupboards and pantries, toilets, steps and landings, simple rooms, common school classrooms etc.

D Free-hand drawing. Introduction to bodily form. After the study of leaf and plant cuttings, the laws of perspective are to be developed by using simple forms and models. After this work in outline drawing follows the study of such objects and implements as are desirable for teaching sharply defined lights and shadows. At first only the umbra and silhouette in black or one color; then attention to the peculiarity and tone worth. Portrayal in charcoal, chalk, pencil, brush, or one color in varying steps. No washed colors or erasing, but sharply defined surfaces. No completed work in still life. Wood painting. Practice in groundwork and graining as set by the teacher. Use of the necessary tools.

Third year

A Tradescraft and citizenship. Description of the tools, implements and the scaffolding and the work of decorative and ordinary painters. Use and care of tools and utensils, especially brushes. The different scaffold work, buck, pole and ladder apparatus, hanging platforms, etc. Rules for the protection and care of apparatus. Description of buildings, sketches and design. Description of the most important methods of applying paint, using textbook on this subject. Painting in ordinary and in oil colors on wood, polished surfaces, and metals. Lacquering on wood and lead. The master as a unit of the trade-union. Trade-union and association methods, that is, parlimentary law etc.

B Plane surface measurements and price calculations. Length and surface measures. Measurement of plane surfaces. Square, rectangle and right-angular measurements. Triangle, trapezium circle, polygon, floor, walls, ceiling, simple and double windows, doors, frames, and drapery fixtures. Mantels, designed from cylinders, cones and balls. Eaves, water pipes, columns, cornices, vault design. Calculations of measurements from working drawing. Foundations of price reckoning. Material, wages, expenses and profits.

The apprentice must receive a grounding in all the difficulties that influence prices so that he understands the care and difficulties that fall to the lot of a master.

C Decorative painting. Continuation of the exercises of the second year, wall plans in simple line outline, with stencil, friezes etc. Corners and panels. Wall and tapestry stenciling. Simple roof and ceiling work. The exercises are somewhat more complicated, two to three color tones in the stenciling and painting. Exercises: rooms, stores, beer halls, clubrooms, vestibules, offices, steps, and halls are to be given by the teacher. Sketching one-twentieth, one-tenth or one-fifth fully completed. In stenciling, geometrical and plant life motives, as well as others suitable from animal life, may be used as far as the student has proceeded in free-hand drawing. The work in free-hand drawing is to be improved and related to the other work as far as possible, and employed at all times.

D Free-hand drawing. Special observation of light and color on usable examples, articles, animals and plants. Portrayal with the least possible color of plant surfaces set off by light and shadow. Use of free-hand drawing work in stencil and frieze patterns and conventionalized designs.

E Wood and marble painting. Continuation of the work of the second year. Framework and filling-in patterns of different kinds of wood. Marble painting and imitation. Practice from nature.

Fourth year

A Drawing. Colors; where they come from, preparation, care of imitation. Lead poisoning. Lacquer, glues. Sketches from the history of decorative painting, Egyptian, Pompeiian, Raphael.

B Tradescraft and citizenship — The master as citizen. State of Hamburg and German constitution. It is positively necessary that the student makes his own at least the important principles in the knowledge of color; this to be done by short dictations and frequent questions.

C Bookkeeping. Ground plan of one method of simple business bookkeeping. Daybook, ledger, cashbook, inventory and exchange. Laws for proof and safety. Tenders. Kasten and Minetti "Bookkeeping for Painters."

D Decorative painting. More difficult problems in handling ceilings and walls. In this work the friezes and stenciling are to be made richer in form and color, and the students are especially to handle difficulties arising from wall surface division by doorways, niches, pillars etc. The division of the ceiling by projecting walls and other irregularities of the ground plan are also to be considered. In the free brush work some place may be given to the construction of leaves, flowers and similar details; still life and color and portrayal of animal life, landscapes, medallions and the human figure do not belong to the scope of students' work and are to be avoided. To the foregoing work add social room for hotel, bedroom, gymnasium, schoolroom, simple music room etc.

E Wood and marble painting. Completion of the former exercises and work for further study in the arts of wood and mantel handling. Syenite and granite.

Lacquerer classes

The lacquerer apprentices of the second, third and fourth years are divided into their respective separate classes. They attend school two days each week from 1 to 4 p. m. They have the theoretical work in common with the painter apprentices of their respective years. The remaining time from 1 to 5 or 6 p. m. is devoted to the practical work.

A Trade instruction. Two-thirds of the 8 or 10 hours will be devoted to practice in free-hand line drawing, with slider on fellies or wheels, right-angle lining, largest possible surface, corresponding to the needs of wagon lacquerers, lead lacquerers, or furniture ornamenters. Small ornamental details, corner work and designs in geometrical and free outline. A few examples in heralds and monograms.

For advanced students. Setting forth of business and delivery wagons with border decorations and lettering. Development of color feeling. These lessons are to be sketched to small scale and later worked out in natural size.

B Wood painting. One-third of 8 to 10 hours devoted to practice in graining and portrayal of important woods. Free-hand drawing and lettering; drawing the large and small letters in the Latin alphabet, union into words, block type. Development from letters into monograms. Studies of leaves, flowers and prepared specimens and their value for ornamental decoration.

Optional classes

These classes are given in the evening only.

A Free-hand drawing. The same principles used in the required work are used here. The evening classes merely afford more time for practice.

B Lettering and sign painting. Further building in the required work and in round script, practice in the Latin printing alphabet, large and small, development of a few important printing scripts and block type in order to strengthen the appreciation for readability, color, blending and harmony, beauty and the completed whole. The student learns to work with the least possible color and materials and to avoid brilliant colors, shadows and double lines. The relation between the script and the bordering or decoration is to be explained. Profession and trade insignias are to be seldom used and never as artistic centers but more as decoration for surface patterns and stenciling, and are to be always secondary to the lettering.

C German. From specially chosen examples from the work on the painters' trade, certain paragraphs of grammar are to be reviewed. Practice in written and oral expression. Letters and post cards of apprentices to relatives. Description of painting work and of rooms that have been or are to be decorated.

D Arithmetic. Decimal fractions and their application. Surface measure, percentage, profit and loss. Course of study in signs, shields, and designs for painter apprentices.

First division. They begin with the drawing of lines and practice with brush work in size and color. Arrangement of ornaments according to previously assigned spacing. Color mixing according to problems outlined. Script painting for spaces assigned. Script drawing. Simple, usable, Gothic and Latin script and the practical application of the same.

Second division. Color mixing from set problems. Color harmony. Painting from set spacing and given examples. Drawing from examples, enlarging and coloring. Independent preparation of mixed colors. Preparation of a few sketches for friezes.

Sketching for wall and ceiling decoration. Drawing modern script and painting the same. Development of placards and posters in painting.

Courses of study for classes in free-hand drawing:

Summer half-year — plant ornaments. Simple, divided, combined leaf forms. Leaf foreshortening and cutting. Flower forms and stems. Leaf preparation and preservation.

Winter half-year — geometrical ornaments. Conventionalize a few butterflies, birds and small animals. Perspective drawing of simple subjects.

An exact division of subjects, week for week, is not possible because the various talents and advancements of the students make a uniform progress impossible; this teaching is therefore mostly individual and not subject to outline.

COMMERCIAL COURSES FOR THE GROCER

(The German system of grading classes is exactly opposite to the American system; thus in commercial schools class IV is the lowest and class I is the highest.)

German three, six hours per week.

Class IV. Reading from a large number of selected pieces. The main object is to secure good pronunciation and enunciation. To secure memory and oral fluency, certain important selections are to be reproduced by the students. A special reading book by J. Schmarje is used. Grammar includes a complete review of the declension of nouns, pronouns, adjectives and much practice in the correct use of imperative prepositions, governing verbs and adjectives. The subject for written work is to be taken from the grocers' trades. Dictation relating to the everyday affairs of a grocery store will alternate with individual work from the experiences of the apprentice. Finally, by use of the blackboard, written examples, and suitable quotations, the students are to be gradually introduced into the phraseology of the grocery. Practice is given in the correct use of commercial terms and in the business vocabulary of the grocery trade. The work is to be sequential and to stimulate interest in the grocery business.

A Examples
  1 Letter to an old friend; aim to secure a position as apprentice; special attention to be given personal and possessive pronouns.
  2 Answer of the friend.
  3 Letter to an incoming proprietor.

4 Answer of the proprietor, directing apprentice to come to see him. The aim in these cases (3 and 4) is to secure a correct, polite form.

B Announcing sale of a grocery business by A; questions of the purchaser B; answer to his question; considering security from third party C.

Class III. The reading practice gives occasion for oral reproduction of what has been read, especially for clear and connected statements. General review of grammar, taking up only the main points, and particularly those liable to give pupils most trouble, as prepositions, governing verbs and adjectives, and pronunciation; explanation of all words and terms especially connected with grocery business. The written work will be restricted to the writing of letters covering all possible relations that might arise in the grocery business, both wholesale and retail, and to practice on written business forms. As a guide Edert's "Mercantile Plans" is used. The instruction in German is directed toward the fixing of the fundamental principles of general commercial practice. In the second half of the year the following chapters of Max Behm's "General Commercial Principles" are taken up: (1) all that has to do with indexing, cataloging, registering and recording in a business office; (2) the postal affairs; (3) shipping of goods.

Class II. The use of the reading book in this class is restricted. Political economy is given special attention. The written work introduces practical business correspondence; for example, advertisements, offering of goods for sale, ordering of goods, letters of credit, circulars, letters of information, letters demanding payment, correspondence with an agent as between debtor and creditor, seeking of employment, references, contracts, and the presenting of requests. In this written work the independent work of the pupils is to be sought. Edert's "Mercantile Plans" is used as a guide. From Max Behm's "General Commercial Principles" will be taken up anything connected with customs, money and exchange.

Commercial penmanship

Class IV. The aim is to acquire a skilful and beautiful handwriting. Practice is given in the German and Latin alphabets, first with the letters singly and then in words. In the last half year follows writing of longer sentences and paragraphs related to the grocer's calling, such as bills, receipts, and addresses.

Class III. Practice is given in the writing of longer articles, the chief aim being legibility and neatness; filling out of business forms and blanks and discussion of same; filling out of entrybook by J. Schmarje; practice of ovals and other ornamental types by such students as are especially gifted for such work.

Arithmetic

Class IV. The four fundamentals in whole numbers, common and decimal fractions. Emphasis is laid on accuracy and completeness as well as on the correct use of arithmetical rules. Simple rule of three, easy lessons in partnership, alligation and division, and from square and cubic measure only that which relates especially to the grocery business. For exercises part I of Prof. M. Löwe's "Lessons in Business Arithmetic" is used, the more difficult problems being omitted in this grade. Afterwards the simpler lessons in percentage from Löwe, part II, with examples taken from the grocers' business, might also be taken up in this class.

Class III. The study of interest (Löwe, part II, p. 19–39) and percentage (Löwe, part I, sec. 9). From partnership the more difficult problems (Löwe, part I, sec. 10 and Löwe, part II, p. 18–19), as well as division (Löwe, part I, sec. 11, and part II, p. 19).

Class II. From Löwe, part II, study the chapters on discount, stocks, and compound interest and the payment of debts. Further, Löwe, part III, introduction into current accounts.

Bookkeeping

Class III. Opening of an inventory, explanation of the terms "inventory" and "balance"; working out of a short "geschäftsganges" with the simplest entries after simple bookkeeping. Further, "geschäftsganges," yearly balance with profit and the same with diminished profit (business expenses through brokerage and commission); loss; account current of the proprietor; increase of capital. Special stress is laid on independent work.

Class II. Taking as a basis a short "geschäftsganges" worked out for two months and following the rules of double entry bookkeeping, the following are discussed and written up: inventory, daybook, cashbook, journal, ledger, monthly balance, general balance and yearly balance. In oral work, chief emphasis is laid on finding out the correct account (debit and credit). In the second half-year follows the independent work of a "geschäftsganges."

Commercial geography

Class II. The geographical possibilities and conditions, both physical and political, of the grocery business and its commerce; the great German coal fields and agricultural centers; the most important agricultural products; the great German steamship lines and their routes of trade; the great European nations, their colonies, important exports and trade in food products; the great commercial centers outside of Europe which are noted for their food trade with Germany. The connection between the physical features of a country and the occupations of its inhabitants with its export products and commercial possibilities, is particularly noted.

Stenography

Class II. The instruction in stenography will be given in the last semester according to the Stolze-Schrey system and the instruction book by Ahrens and Petersen. Special stress on the consonant signs arranged in groups and of the vowels symbolically represented through these. The use of combinations of consecutive vowels and consonants. Practice of a few special rules of writing; at the same time to acquire in connection with related material the prefixes, suffixes, and contractions that will be needed later in the business.

Foreign language

Courses in foreign languages are elective. Attention is called to the importance of a practical mastery of the foreign language as it is used in business life. To this end there is as great a restriction as possible in grammatical rules and much practice in oral and written expressions, translation of letters, and business correspondence and conversation.

Students from all classes and courses may take this work.

Commercial instruction

Commercial instruction in class I is characterized by a further repetition of the material acquired in the former classes and minute dealings of exchange. Further banking, stock exchange and board of trades; stocks and bonds; a few of the most important terms of commercial law, board of trade and of the constitution.

TEACHERS

More important by far than these courses of study are the teachers who are to present this work in a manner so practical as to appeal to the most ardent tradesman and at the same time with stimulated interest and according to the correct rules of pedagogy. A general sketch of the Hamburg faculty is here given, followed by a more detailed account of the selection, instruction and division of teachers.

Each of the four schools in the main trade school building is under its own director, a man of special skill and experience in his particular branches, and the head trade school itself is under Prof. Dr Weckwerk, previously mentioned. All other public continuation schools are under Inspector Kasten, and each of the union trade schools has its separately chosen director responsible to the union. The head trade school for evening and Sunday schools is under a director chosen by the inspector, and each of the ten schools held in public school buildings has its own director. Five are directors in the same building during the day; of the remaining five, three have the advanced license and are teachers in high schools and only two are ordinary day school teachers.

In these ten evening schools are employed 223 teachers, of whom 45 are tradesmen, 5 rectors in day schools, 9 teachers in high schools and 164 common school teachers or special language teachers. Of these 223 men, 40 are employed only half-yearly, 10 in summer and 30 in winter; and of these 40, only 14 are tradesmen of whom 10 teach in winter and 4 in summer. Thus we see that in the evening schools where nearly all theory is taught there are 178 professional teachers to 45 tradesmen, and of these 178 teachers only 26 are employed half-yearly, while 20 of the 26 are employed in the winter half-year when day schools are in full session. In general, we may say that in all trade schools the professional teacher is used for theory and as far as possible for the elementary technical work, the advanced technical work and certain advanced theory being left to the mechanic. In the elementary classes the professional teacher is needed for methods and discipline and he can easily master the technical side of the work. As soon as the technical side supersedes the pedagogical, the mechanic replaces the teacher. Mechanics exclusively are used in the workshops and laboratories and in the union trade schools, and the advanced theory is taught either by a professional teacher who has been through the course in practical training or by a workman who has attended the course in pedagogy. Thus trade drawing, drawing in upper classes and some few elementary classes, tradescraft, and ship and machinery design are usually taught by experts. The teachers of artistic painting, decorating, and frescoing are artists and have their private studios, often in the school building. Having taken the course in pedagogy, they teach as a side line. In the plumbers' school of Hamburg, German, writing, bookkeeping, tradescraft and certain work in the lower trade classes are done by professional teachers while the trade drawing, design, shopwork and upper classes are under mechanics from the technikum. All the practical work in the street pavers' classes is done by a mechanic who is employed only two months in winter when street work is stopped; but in the Harburg school for bakers very excellent work is being done by a day school teacher who has made a study of the bakery business for this purpose. The actual work is done in the bakery, but this teacher discusses potash and yeast, what they are, how to make them, how they affect food; simple chemistry; special baking powders; conditions producing chalk in bread; and all sorts of weight and price calculation. This illustrates what is meant by the advanced classes in theory which are usually taught by a tradesman.

In the school in Altona for the building trades, arithmetic, German, elementary drawing, citizenship and the beginning classes in tradescraft are taught by professional teachers; mechanical drawing, patternmaking, construction and shop are under the mechanical builders. First year drawing for plumbers is taught by a day school teacher. Second year work in technical theory, arrangement of water pipes, flow of water, measurements, and general orders are well taught by a day school teacher who has taken the course under an engineer from the technikum. Third year work is taught entirely by professional plumbers.

Even in the commercial schools the same division is found. The first half-year of bookkeeping is left to a day school teacher; the second half-year to a professional bookkeeper. Correspondence I has a tradesman; correspondence II has a day teacher who has made special preparation. Only in the most advanced schools like the technikum and the shipbuilding school is there an entire faculty of mechanical teachers, and here the festangestellt or permanently hired teachers are in the majority.

In the continuation schools the permanently fixed teachers are a minority, the greater number being employed from year to year by the hour. The permanent teachers received from $1000 to $1750 per year, the usual increase being $150 every three years. Those who are paid by the hour receive 62½ cents per hour the first three years and 75 cents per hour after the third year. College graduates, engineers, or modern language teachers receive 75 cents per hour, increasing to 94 cents per hour after three years. In Altona the teachers are paid $27.50 per year-hour when hired by the year, and 75 cents per hour when hired by the hour; nearly all are day school men and are very carefully selected. Candidates send written application to the director who communicates at once with the schulrat to ascertain their standing in the public schools. From this information he prepares a list and visits these men in their classes, afterwards selecting the most suitable for the vacancies to be filled. They are usually over 30 years of age, as experience has shown that younger men are not successful in the trade schools. They are required to sign a contract to teach four hours per week or less, at the pleasure of the director and to enter a preparatory class. The one drawback to this plan is the opposition of the day school rectors, who do not approve of their teachers working evenings; but experience has proved that the ordinary teacher can teach up to 8 or 10 hours per week in the continuation schools without affecting the other work, and their contract permits them to stop at 4 hours, although there is no law limiting their evening work as is the case in Hamburg. Rectors of day schools are selected whereever possible and mechanics are in demand, but very scarce, as they must be especially adapted for teaching. The tradesman teacher does excellent work in practice and theory with one pupil, but they neither like the work nor achieve much success in class teaching.

The preparatory class which all teachers enter is conducted by the director and continues for one year, developing the pedagogical side of industrial education, aims and spirit of the work and the more specific sides of certain subjects, such as bookkeeping. No teacher is employed until he has satisfactorily completed this work, and his chances then are much increased if he has voluntarily interested himself in the technical side of the work. Besides visiting the technical classes of the school, many teachers attend regular courses of lectures on technical instruction which are held in various cities of Prussia for three, four and six weeks at a time by the central government. Others visit shops to get accurate information in advance of their classes, take work provided by the trade-unions, attend classes in building, carpentry and machine construction schools and occasionally work in some trade or business. All of this work, however, is voluntary; no teachers are sent into shops, stores and schools at the school expense to acquire knowledge for use in teaching. In this respect, Altona can not rival Hamburg, where the selection and training of teachers has been raised to a science.

For the training of teachers the city provides four special classes which are open to any candidate for a teaching position in the continuation school upon application to the inspector or director. From the registration lists, the inspector selects his names and forwards them to the oberschulbehürde controlling the public day schools, which returns a record for each name, showing the teacher's education, certificates granted, ability, success as a teacher and the reports of the inspector, all of which are kept in a permanent record. To this record are later added the candidate's class record, ability, personality and attendance as reported by the special teacher and observed by the inspector. From this completed record the teachers are selected, after finishing one year's preparatory study.

TRAINING THE ELEMENTARY TEACHER IN MECHANICAL BRANCHES

The largest number of names on this list represents the day school teachers and comes from the registration in a technological course for increasing the efficiency of such teachers in practical trades. The course was started in 1906 upon the joint recommendation of the inspector and director, and placed in charge of Herr Oberlehrer Engineer Siefkin, one of the best instructors in the technikum. The members of this class receive free as textbooks " Sketches from Lectures on Machine Technology," by the teacher. The tools and apparatus needed for descriptions in the lectures of the course are loaned, as needed, by the firm of Ortmann & Herbst. In order to base the course upon those things that are most practical and necessary and to avoid all matter that tends to interfere with the main objects of the work, a large variety of single sheets, prospectuses, cuts and catalogs showing the newest and most essential features of every trade, are handed out gratis, having been furnished free by different firms upon request of Herr Siefkin. In order to illustrate and explain the plants for the handling and transporting of molten metal, bronze, tin plate, rolled plate, slagg, fuel, etc. the teacher prepared 110 lantern slides of rolling and stamping mills, which are used for one lecture of the course, open to outsiders, and held in the city museum hall loaned for that purpose.

By request of Schulrat Prof. Dr Stuhlman, the upper classes of the technikum were invited to the last lecture and appeared in full numbers. They represent the future expert teachers in the continuation schools. Practical expeditions conducted by the instructor are also a feature of the course. During the last year the following places of business have been visited and studied: J. H. & H. Menk, metal and iron works; Hamburg mint; Ferdinand Stripp, tin and lacquerware factory; D. H. W. Schultz & Son, bronzeware factory; Gebruder Lamberg & Co., rolled tin plate; C. H. E. Eggers & Co., money cases and cash register factory; enamel factory in Bergdorf; Blohm & Volfs, shipyard and machine factory; Ferdinand Müller, bronze and brass factory; Ortmann & Herbst, machine factory. The owners of these plants were more than willing to throw open their factories, and often assisted in the explanation to the class.

At the suggestion of Herr Siefkin, the trade school board permitted thirty-six of his students to accompany him upon a trip into the South to visit the Peiner rolling mills and Llseder smelting works, the city voting a certain sum for the two days' trip. The teachers and students reported much profit from the trip, and that every courtesy and assistance in studying these vast works was shown them.

Since a perfect equipment for technical teaching and an intelligent attendance upon the foregoing technological course demand that the teacher be able to sketch quickly and accurately simple tools and machines, upon the suggestion of Director Weckwerk and Inspector Kasten, the board decided to establish a course in practical sketching. This work was also allotted to Herr Siefkin for two hours weekly, Wednesday from 4.30 to 6.30 in the head trade school, and extended over six winter months. The course was free and 32 men availed themselves of this instruction, 26 from trade schools and 6 advance students in the head school. Acting upon suggestions from the same two gentlemen, there was started a second course giving special attention to practice in the drawing of tools, implements, and vessels needed for instruction in the boys elementary classes. This class met four hours weekly for six months under direction of drawing inspector F. Burns, director of the Ludwig strasse gewerbeschule, and had 23 teachers attending. Still another class, designed to increase the efficiency of the new teachers in the tinkers trade school, is to be formed upon Inspector Kasten's advice. This class deals with the building technic necessary for the teaching of tradescraft and trade drawing in classes 1 and 2, and is similar to one under Diplom Engineer Steinbach, a teacher in the building trade school, who conducts a biweekly six months' course for technikers on methods in building plumbing, roof metal work and mechanics. During the year the teachers in the tinkers school, together with Inspector Kasten, visited many factories including, among others, Gebruder Ebel's zinc press factory and the installation and pneumatic pipe factory of K. A. Gutknecht.

Nor are these courses and visits, good as they are, considered entirely sufficient. Two elementary teachers have been sent into the workshops to work, one in a shop for locksmiths and the other in a plumbing and tinsmith's establishment. Here they do the regular daily work of the trade, bringing specimens of their work to the school and often making the models needed for instruction. They are rapidly put through the paces of an apprentice and are then returned to teach the theory and bookwork as allied to practice in the lower trade classes of the school. They advise and consult with the other teachers and make the most valuable instructors for elementary trade courses. The mechanics are not entirely in favor of this method, fearing it will lead to the adoption of school workshops and a decrease of the apprenticeship system.

The inspector picked a fine boy from the graduating class and sent him into the workshops for special work and to make models for the school. Later this young man will be placed in the pedagogical course " Training the Mechanic in Pedagogy," and will become a valuable teacher of elementary classes.

TRAINING THE MECHANIC IN PEDAGOGY

This class for training the practical workman in educational principles is conducted by Director Prof. Dr Weckwerk of the head trade school. All mechanics who are prospective teachers must attend its Wednesday night sessions from 7 to 9, where they receive instruction on the aims and ideals of the school, methods, the particular aim of each division of the school, order, attention, questioning, and timesaving methods, supplemented by visits to various classes and excursions through the school. Occasionally the fore part of an hour will be devoted to a lecture and the latter part to visiting a class or classes where the instruction of the lecture is being given a practical application. Again a series of visits are made, the director explaining the continuity of the work and the relation between the gewerbeschule, the technikum and other more advanced schools. During these visits, and in fact at all times, the mechanical and professional teachers consult, each supplying information that is needed by the other. As an evidence of the personal interest taken by mechanics in improving themselves as teachers, may be mentioned the fact that this class on its tours of inspection frequently met technikers visiting the classes on their own initiative, inspecting the work, questioning the professional teachers and gathering all possible information. They even familiarize themselves with certain of the commercial branches in order to understand better the theoretical side.

TRAINING THE COMMERCIAL TEACHER

For supplying training in commercial branches to mechanical teachers and more especially to day school teachers who are being fitted as instructors in the continuation commercial schools, a very excellent course has been established. An elementary teacher of unusual promise was selected by the inspector and sent to the Banker Verein Bank for six months' practical work. He was then transferred to a wholesale house for six months, and later to an import and export company, where he remained for an entire year. Next he was sent for some months into the office of a shipping and transfer company, and finished up with four to six weeks in a large department store. This man is now the head teacher of banking, bookkeeping and commercial arithmetic and also the instructor in a one-year course in practical commercial work for all elementary teachers who desire to teach in the commercial trade school. The class in which the writer participated was held in the armory and consisted of twenty-five intelligent young day school teachers. The teacher had a quick businesslike manner that pervaded the entire work of the class. The study for this period included exchange, letters of credit, discounts and foreign paper. The schulebehürde had allowed this teacher his salary during the time of his apprenticeship in these business houses, but anyone who observed the speed and assurance with which he presented topic after topic from both the practical and pedagogical side, would have no doubt of the ample returns made to the city for the money so expended.

PUPILS

If the preparation of teachers is important, the preparation of pupils is more so. The vast majority of continuation school pupils receive their elementary education in the volkschule or common free school, and to form an intelligent idea of what this education is, it will be necessary to say a few words about these schools.

In Altona there are two grades of schools below the higher pay schools, the volkschule and the mittleschule. The former has a course of study similar to the first six years of our ordinary union schools, with religion and gymnastics added as regular subjects. The mittleschule includes all this to a higher degree, with history, science, modern language and elementary algebra and geometry added; the course extends over nine years and a small tuition is charged. The Hamburg volkschule is a combination of these two, containing all these subjects condensed into a seven years' course of study with an extra advanced year called "selecta." These classes begin with 8 so that 3, 2 and 1 are the highest standards. Drawing, with the emphasis laid on the accuracy of portrayal in general work rather than upon color and impression, and geometrical construction are prominent features of the work in all schools.

Graduates of a mittleschule may attend a realschule, or still higher institution, for one year more and pass the einjährige examen, entitling them to serve only one year in the army instead of three; but even this indorsement has little effect upon the trade school pupils. Of all apprentices registered in carpentry, two-fifths are from class III of the volkschule, the remaining three-fifths from classes II and I and none from the higher schools. There are 405 locksmiths and small metal workers and not one has the einjährige examen. Only 25 come from selecta, the fourth year of a six-year course, or fifth year of a nine-year course in higher schools. Two hundred and eighteen are from class I of the Hamburg volkschule, the third year of a six-year course, or fourth year of a nine-year course in higher schools. One hundred and nineteen come from class II of the Hamburg volkschule, or the third year of a higher school; 33 come from class III of the volkschule, or lower; 8 come from village schools and 2 from a one-class country school. The tinsmiths show much the same previous education, einjährige, 0; selecta, 17; volkschule I, 165; volkschule II, 93; volkschule III, or lower, 45; villages, 1; country, 0.

Even in the commercial school the same previous training is found, but there is a greater percentage from the higher volkschule classes.

The French I class contained 16 boys, all of whom were from the volkschule, and a majority from selecta. The arithmetic III class contained 13 boys, 6 of whom were from selecta and all but 1 from the volkschule; the bookkeeping I class contained 18 boys — fine looking and very orderly — mostly from selecta; all but 1 were from the volkschule; the German I class contained 14 boys, 13 of whom were from the volkeschule and 1 from the realschule.

It is also of interest to note the general lines of business whose apprentices frequent the commercial schools most. Thus in the French III class the majority come from counting and importing houses, very few from firms doing strictly local business, and none from stores. In the French II class of the second half year in school are boys from importing, exporting, banking and shipping houses, one wholesale clerk, one gardener and no retailer. German III has 20 boys of whom only 2 are in retail work. Correspondence II has 8 boys, all from import and export firms. The percentage of retail clerks is rather higher than appears here and Hamburg's position as one of the largest ports in Europe naturally raises the number from import and export houses and shipping firms. In the classes for girls the percentage of retailers is large and the work practically the same as given to young men. Contrary to the fixed German custom, men and women in the commercial continuation schools are instructed in the same building and under the same government, but the classes are never coeducational, and, with very few exceptions, the teachers are men. The girls are fully equal to the boys in everything except mental arithmetic, and during their school course are earning from $5 to $12.50 per month in business houses. This is a very good showing when it is remembered that, after completing school, girls start on the low wages of $10 to $18.75 per month and that their increases are slow. In deportment and interest the girls excel the boys. In general, attention and interest vary with the teacher exactly the same as they do in any other school, but are best in the laboratories and poorest in the drawing classes, although the trouble here is due much more to their phlegmatic dispositions than to any acute indifference. There were professional teachers and mechanical teachers who had excellent order and attention, and both classes of teachers who had some disorder and idleness; it seemed to depend upon the personality of the teacher entirely and it was not conspicuous that either class was superior to the other.

The same indifference was surprisingly apparent when the apprentices were consulted regarding their work in the school. This was more marked in Altona than in the voluntary schools of Hamburg, but there was a general apathy among a large number of boys questioned, as to whether they came to school or not. Only one really objected to being forced into school; the usual answer was that he did not care, he would just as soon come as not as long as he got his time allowed for it. There were a few in both cities who spoke highly of the school work and of the opportunity so to advance themselves; but this number was less than might be expected and the same indifference is also manifested in the further upbuilding of the students after leaving the continuation school, as only 10 per cent of the masons and carpenters go into the building trades school, 5 per cent of the mechanics go on in the machine builders school and less than 5 per cent of the others find their way into various advanced technical schools. These very facts, however, emphasize the need of the continuation schools, the schools for the beginners; and that they are primarily for the apprentices and are so considered the following table shows:

Total number of students	2474
Apprentices	2408
Journeymen	44
Independent workmen	2
Unclassified	11
Teachers and students	9

These 2474 pupils are also divided as follows:

Teachers and scholars	9
Laborers	114
Unclassified	11
Specific trades	2340

The largest of these specific trades here represented is that of machine builder, with 491; but locksmiths and tinsmiths each have over 400 and masons number 379. Eight trades are represented by one apprentice each, namely, watchmaker, photographer, engraver (the others attend the kunstgewerschule), sailmaker, candymaker, glazier (special school), brushmaker and cooper. In general, the representation is small in any one trade; only 8 of the 67 trades have 50 or more apprentices in the school. These are figures for Hamburg (those for Altona are not of so much interest, as all apprentices there are compelled to attend school) and the total increase is not all that might be expected.

1905		1906	
Winter	Summer	Winter	Summer
3041	2506	3281	2769

The present numbers are 3447 and 2911 and it is estimated that compulsory education would nearly double these figures. Taken as a whole, the German student is a very satisfactory and orderly pupil, not overenthusiastic or ambitious, but doing excellent work and steadily advancing the standards of the great industrial army.

CLASSES FOR WOMEN

Whatever may be said of the other classes in the continuation schools, there can be no doubt of the interest and enthusiasm displayed by the pupils in those special classes established for the wives and daughters of tradesmen and shopkeepers. These women, who are known as the handwerkerfrauen, come from every conceivable trade and business to attend a course of 2 to 4 hours weekly established jointly by the trade-unions interested in the school and by the city authorities. The curriculum includes bookkeeping, business arithmetic, commercial practice, all forms of business paper, banking, shipping, and other subjects and is intended to give these women a thorough elementary business education in order that they may assist their husbands and fathers in conducting their work along sound, business principles. Through their influence many a shiftless business has been systematized and put on a paying basis and many a mechanic or laborer has found the practical principles of finance applied to his household a great incentive to saving. These classes in both Altona and Hamburg are one of the best paying investments of the schools. The course in Altona is entirely free and the attendance voluntary; the director himself instructs the class and the schoolroom was filled at every meeting with fine looking, intelligent, ambitious women from 18 to 35 who gave perfect attention and learned with surprising rapidity.

BLANKS, RECORDS, AND REPORTS

Not only are these various classes organized to fill a want but they are organized and conducted according to a system, which in itself is an education to students who come in contact with it. Every student upon entry fills out a registration blank giving the name, age, occupation, employer, school and class recently attended and all other information necessary to the records of the institution; he receives an assignment card, which is necessary for entering the classes designated for him, and a zeugnisbuch, in which his school records are to be kept. The Altona book, which is a good example, contains the following form:

Date of entrance	Class	GENERAL REPORT			ATTENDANCE		Tardiness	SUBJECTS								Remarks	SIGNATURES	
		Deportment	Industry and attention	System	Absence			Tradecraft	Reading	Bus. comp.	Writing	Reckoning	Geom. and Alg.	Bookkeeping	Drawing		Class teacher Director	Employer
					With satisfactory excuse Hours	Without satisfactory excuse Hours												

It will be noted that the employer and not the parent receives and signs these books. The records of all students are systematically kept, courses of study and daily programs are printed and distributed wherever needed, an annual report giving in detail the various trades, their classes, numbers of apprentices, and all the general information about the school, is printed. In addition to these routine blanks the classes are supplied with every possible blank, chart and table needed for the teaching work. They use receipts, bills, and filing cards direct from the business houses, together with checks, drafts, money orders and postal notes, packet post, notes and exchangeable paper, tax sheets, poll sheets and similar blanks which are filled out by the various classes. Shipping paper, bills of lading, importing and exporting blanks, customs sheets and other forms, precisely as used in business, are purchased or furnished by the government, and used in the commercial classes. Railroad time-tables, freight rates, shipping rates and tabulated data of all kinds are furnished by the various companies; and even a hotel call boy is instructed in reading and interpreting such of these tables as give the information generally needed by the traveler.

TUITION AND FINANCE

The same exact system of records is applied even more strictly to the financial reports. The yearly estimates are made out to the smallest detail by the various directors, as follows: hauptgewerbeschule, kunstgewerbeschule, technikum, schiffsbauschule and machinenbauschule. Requisition for all other gewerbeschulen is made by the inspector. The requisitions for the hauptschule and those from the inspector go to one subcommittee; each of the others goes to its special subcommittee and must be approved by it before being submitted to the upper trade school board of education. After approval by this general board, the joint budget is sent to the Hamburg bürgerschaft and senate. After it passes these bodies, it becomes the fixed amount to be paid by the main treasury to the subtreasury for trade school administration. There is also a subtreasury for common schools and one for higher schools receiving their funds in the same manner.

The yearly reports of actual expenses, made out and approved in the same manner, are published either in the annual reports or in separate financial reports giving general items of interest; but the data given below are taken from private reports furnished by the inspector and directors of the schools and afterward reviewed by them. Because of the great interest that centers in the financial side of the question, these figures are given somewhat completely and with comparisons to other expenses. It is to be remembered that the difference in monetary standard and cost of living between Germany and the United States, as well as the difference in the amount of assistance such schools may naturally expect from the central government and from the trade-unions, which, not being in money but in material, does not appear in financial statements, makes it impossible to offer these figures as estimates for this country. We may, however, form a fair estimate by comparing them with the city's total expenses, which leads to but one conclusion, that wherever a city or village is satisfied to begin slowly, using its public schools and such other buildings and material as are at hand, the finances of a trade school are not the prohibitive feature they otherwise seem to be.

Whether tuition should be applied in this country to a reduction of the expense is a doubtful question. Certainly in day schools that educate pupils under legal school age there should be no tuition, and likewise no tuition in schools in which the education is compulsory. For pupils above school age and in evening schools a small tuition might be charged; the Germans find that students who pay tuition work better than those who do not, and where the employer pays the tuition he exhibits a livelier interest in the school.

Tuition in Hamburg is very small. For entrance to trade classes $2.45 for six months is payable in advance or by the day after registration. Elementary classes for boys charge $1.50 per half year and the master's course in the Chamber of Commerce costs $1.25 for 40 hours' instruction. The commercial course is $1.50

for six months; the single trade-union schools charge from $1.50 to $2 for the half year and the same prices apply to all girls classes in the regular continuation schools. The day students in the hauptgewerbeschule pay $12 per year; in the wagenbauschule $25 a year; in the kunstgewerbeschule $12 a year except in painting classes, where material costs $5 extra. The technikum charges from $12.50 to $18 for six months and in the building trade school the tuition is from $6 to $22.50 a year. In Altona those apprentices who attend the kunstgewerbeschule pay $12.50 per year for day and evening classes, and $5 per year for evening and Sunday classes with permission to attend two day classes a week. The domestic economy school in Altona is free; but the principal one in Hamburg is a private day school charging $35 a year for morning instruction, $42.50 with one modern language added, $50 from 9 a. m. to 2 p. m. with two modern languages and $55 for work from 9 a. m. to 3 p. m. Single classes in modern language cost from $15 to $20 a year and other classes from $5 to $15 a year. Except for this school, the additional finances needed for the general expenses are furnished by the city and the trade-unions together.

The educational finances of Hamburg are disbursed by an oberschulbehürde divided into four sections:

1 For scientific institutions, botanical gardens, etc.
2 For common schools
3 For higher schools
4 For land schools

All but the first item of the following table is handled by this board:

1	Total expenses of the city	$42 845 291 90
2	Art gallery	42 965 20
3	Music hall	57 500 ..
4	Common schools	3 047 656 ..
5	Higher schools	752 478 60
6	Zoological, botanical gardens and science	333 367 80
7	All continuation and technical schools	292 303 ..

Divisions of industrial school finances

8	Commercial schools, 2278 pupils		18 250 ..
	Tuition received, $6000.		
	Expended for teaching	$16 500	
	Clerks, printing, stamps	675	

Cleaning	625	
Light	450	
9 Girls commercial school, 757 pupils		$8 000
Tuition received, $1625.		
Expended for teaching	6 750	
Clerks, printing, stamps, light, books, typewriters	1 050	
For cleaning	200	

NOTE. The cost of buildings, other than light and cleaning, is not included in the above as, with the exception of a normal training school for men, they are public day schools.

10 Trade schools for boys, 6281 pupils		$80 000
Tuition received, $18,750.		
For teaching	$60 000	
Models, shops and material	10 000	
For cleaning	2 225	
For light from $3000 to	3 500	
For heat, estimated	1 125	

NOTE. Fifteen to 18 electric lights such as are used in the ordinary shoproom are figured at $75 a year.

11 Hauptgewerbeschule, largest of the schools included under topic 10.

For boys 2240 pupils.

Divided into wagenbauschule and day and evening trade school.

Receipts

25 students (day) at $12	$300
15 students (wagon) at $25	375
2200 students (regular) at $5	11 000
Total	$11 675
Approximate reduction 25% for free places	2 925
	$8 750
State aid	33 000
Total	$41 750

Expenses

Director	$2 600
2 teachers, class I	2 700
7 teachers, class II	7 200

2 teachers for special work	$300	
Teachers by the hour	21 225	
Student assistants	150	
Room rent, special	1 800	
Models, books, material and furniture	2 250	
Printing	300	
Traveling expenses	250	
Heating and lighting outside rooms	2 250	
Incidentals	550	
Total	$41 575	
Receipts		$41 750
Expenses		41 575
Balance		$175

A few interesting comparisons may be made from these figures. The sum of items 8, 9 and 10 ($106,250) is the total cost of the continuation schools for young men and women and apprentices. This amount, compared with item 7, shows that these schools receive 36 per cent of the money expended by the city on its technical education. From item 4 we see that these schools cost 3.4 per cent of the sum devoted to common school education. Item 5 shows that the expense for continuation schools is 14 per cent of the sum expended for higher education, and item 6 shows that the continuation schools cost only 32 per cent of the sum paid out for zoological and botanical gardens and kindred sciences. Items 2 and 3 show that almost as large a sum is devoted to the art gallery and music hall as is expended for trade school education; and item 1 shows that only one-fourth of one per cent of the total expenses of the city finds its way into the treasury of the continuation schools.

With this expenditure, Hamburg maintains one of the best and most thorough systems of industrial education in Germany; but compulsory education would largely increase this expense.

Passing on to Altona, a city of 180,000 inhabitants, the following expenses are given:

Director	$ 1 550 ..
3 teachers, class I	2 400 ..
Bureau of administration	593 ..

Teachers by the hour		11 375 ..
Janitor		125 ..
Clerks		550 ..
Supplies		550 00
Printing		188 12
Incidentals		100 ..
Work, light, cleaning, inventory		1 750 ..
Barbers school, heat and light		37 50
Repairs		500 ..
Commercial school		
Director	$ 200 ..	
Teaching force	2 887 ..	
Janitor	45 ..	
Supplies	216 ..	
Rewards	54 ..	
Printing	32 40	
Incidentals	21 60	
	$3 456 ..	3 456 ..
Total		$23 174 62

This represents the total expense of the city of Altona for gewerbe and commercial schools.

The barbers school, previously described, may be given as an example of the semipublic school.

172 pupils		$825
Received from the city	$125	
Received from the union	375	
	$500	500
Remainder		$325

This remainder of $325 is made up from tuition and gifts.

A semiprivate class in domestic economy for girls is being well conducted in Altona. There are 30 pupils and the cost is $300 per year, including instruction but not raw material. The class meets two evenings per week and material is figured at 15 cents per girl per week.

As has been said before, these figures are not offered as criterions for America, but as an example of the European results obtained by small, judicious expenditures.

TEXTBOOKS

If this question of finance is the greatest problem confronting those who are to establish the continuation schools, the problems of securing satisfactory teachers and textbooks are equally difficult for those who are to continue to direct the work. How these German cities have solved the first of these difficulties has been outlined; the second one, although long under consideration, is far from any solution that produces entirely satisfactory results.

The entire system of German trade education is the result of the combined and coordinated efforts of practical business men and professional school teachers. Nowhere is this more apparent than in the textbooks and pamphlets. Except for the textbooks that are essentially technical, such as those for use in the workshops and laboratories, and the pamphlets used in the mechanical drawing and designing classes, all the books have been written by practical tradesmen in collaboration with a professional teacher trained in the arts of pedagogy and school economy. The practical man is generally the technical teacher of the subject treated; but he is sometimes an outsider, a member of the union, who is a master of his trade but does not teach it. This work is sometimes prepared and submitted to a committee of the union which passes upon it before adoption, and the union is often very particular about the information and problems to be given in their trade school classes. The professional teacher, who is frequently the joint author of nearly all the textbooks used in his school, is very often a director of the school, although this work is done also by teachers in the specific classes for which the book is provided. In general, we may say that reading books, conversation books, works on the history and description of trades, textbooks relating to articles, tools, and materials, are written by the director and a mechanic, the teacher and mechanic, or by the director and a teacher who has been given special mechanical training along the line of work treated in the textbook.

These texts relate all the general information they contain directly to the trade that is being taught. Thus arithmetic, geography, history, and other subjects are taught only so far as they affect this trade, and the trade itself is at all times emphasized by the teacher in the classroom, and the fact that general culture is included in the instruction is kept in the background. Two examples will suffice to illustrate the general makeup of these textbooks.

The text in arithmetic used in Altona was written by the director in collaboration with several skilled mechanics. It is in two volumes, the first of which is divided into two parts. All the classes are put through the fundamental processes and general information contained in part I, such as addition, subtraction, multiplication, division, practical parts of percentage, notes, checks and banking, receipts, bills, transportation, tables of rates, freight, packet post, and interest. Certain parts of the latter work are divided to suit different groups of trade. The examples and practical applications of these principles are found in part II, divided into sections prepared especially for the different trades so that the plumbers and carpenters would be given entirely different examples to illustrate the same principles. The second book is divided into a large number of parts, one for each trade. All the advanced work is taught in this highly specialized manner.

Bookkeeping is taught in the same manner. The principles of single and double entry and American bookkeeping are taught from the blackboard to all pupils alike. There are then distributed to the various trades a large number of small pamphlets containing all manner of examples which have been passed upon by practical men as arising in the regular business routine of the trade they are intended to exemplify.

A trade school reading book, while written so as to produce good readers and cultivate a literary style, contains articles on history and government, trades, machines and inventors, unions and apprenticeship, biography tending to kindle ambition, and those topics directly or indirectly related to the student's later life. They are, like the other two books mentioned, the product of much study and experience and are seldom used in any but the school for which they are prepared.

Even after all this labor, there is much dissatisfaction felt regarding textbooks; improvements are continually demanded by the authors themselves and as yet there has been found no means of supplying textbooks for any but the particular school or city in which they are produced. There are very few general textbooks on trade school education used in Germany.

SPECIAL VISITS

During the many visits to the technical classes, attention was called here and there to interesting points that do not seem to fall naturally under any one of the general topics and they are therefore included under this heading.

Thus the application of physics to the trades as taught in the day classes of the head trade school is worthy of mention. Here, in a thoroughly equipped laboratory, the students deal with the center of gravity of walls variously constructed, wind pressure on chimneys and wall, effect of temperature and moisture on construction, roof pressures, mechanical laws and similar practical calculations. Boat builders deal with fluid pressure, displacement, and resistance in their scientific aspects, in order to better understand the application when made in their regular classes. Other trades are dealt with in the same manner.

In the commercial schools for girls are classes in French and English conducted on the conversation principle. These classes are largely attended by the English teachers in the girls common schools of Hamburg. The teacher is sometimes a native and sometimes a German, but always able to speak the language fluently and to carry on the work of the class entirely in the language being taught. Girls often attend these classes to learn sufficient foreign language to assist their parents, who trade with France and England. The instruction is absolutely free. The work extends over two years, in four half-yearly courses, meeting four hours each week. The courses include conversations in stores and shops, simple letter writing, business letters, terms and expressions, besides the regular elementary grammar and the reading of such books as "Journeys in England" for pronunciation and practice in literary style. Translations into the home tongue are seldom made in any language classes; the advanced classes in stenography, however, transcribe their notes into both English and German and take dictation in English to be transcribed into German. There is also an advanced conversation class in English for common school teachers, taught by an Englishwoman, and similar classes in English and French for boys in their own commercial schools. The higher classes in English, French, and German correspondence for boys include such topics as state papers, state correspondence, interstate commerce, when the state and when the individual is liable for damage and neglect, whose duty it is to attend to various points relating to shipments over state lines and such high grade information.

On a different plane, but equally important, comes the work in plumbing classes. Outlines of houses and buildings are given and these students draw the piping for gas, water and electricity. Costs are estimated for actual cases, as are the costs of tin and lead when various methods of soldering are used. These students also study the physics of the electric lamp, stove and motor, heat, conduction, convection and radiation, simple geometry and its application in cutting tin and metal, and they study thoroughly the sewerage and electric lighting systems of the city of Hamburg. They are taught all the signs used by the electricians upon their plans and drawings and all their general electrical terms and the designation on drawings.

The milk boys study the delivery of milk by shortest routes upon maps of the city; they are taught the methods of handling milk on the railroad and its times of arrival at various stations, as shown on the government time-tables, in addition to inspection, sanitation and elementary chemistry.

The butchers have colored charts of every kind of meat, the cuts, prices, and outlines of animals for naming cuts. The locksmiths not only make patterns of locks, keys, plaster and putty casts from which actual keys and locks are cut, filed, polished and put together, but they are taught fancy locks, drawing and designs for art doors, elaborate locks and keys for massive doors, unique ironwork, fence and window iron, gates, fountains, railings, and the design and construction of all these.

A noticeable thing in all trade school classes is the excessive neatness in the drawing and written work. Even the preliminary sketch must be clean and presentable and the finished work, be it painted, drawn or written, must be without blemish. This is nowhere more apparent than in the notebooks which are used to contain all the written work, tables, blanks, and forms, and in the practical work of the classroom that is to be kept for later reference in business. These books are models of neatness and arrangement, although penmanship is not taught as such in trade schools generally. This lack of attention is often apparent in the poor writing of the pupils.

ATTENDANCE

Up to this time the internal working of these schools has been discussed; now we shall turn our attention to what may be called the external working. However well the internal affairs have been planned and provided for, nothing will be done until the pupils are provided and arrangements made to secure their regular attendance.

There are four distinct classes of schools in Germany so far as attendance is concerned: (1) those in which attendance is voluntary; (2) those in which the individual employer requires his apprentices to attend classes; (3) those in which the trade-unions compel employers to send their apprentices to trade schools; (4) those in which there is state compulsory attendance.

Practically all trade schools in the German Empire began as schools of voluntary attendance and have developed through stages 2, 3 and 4 in the order given. Hamburg is still in the second and third stages, but working steadily toward compulsory attendance. The fact that it would nearly double the cost of such schools is a strong factor in retarding the final adoption of compulsory trade schools.

Prussia has had compulsory education for a number of years and Altona has a perfectly working attendance system. In the early days it was much more difficult to get the merchants to send their apprentices into the trade schools than it was to obtain boys from the shops. The merchant had time and ability to teach his boys everything needed in his special line, and was slow to admit any advantage in allowing them time for schooling; the mechanic early recognized his inability to teach the theory or any cultural subject and was quick to appreciate the gain to himself and to his apprentices afforded by the trade classes. Attendance was therefore better in mechanical classes and this side of the school developed most rapidly.

As specialization in business, keen competition, piecework and the world market crowded out the original general dealer and made higher educated clerks necessary, the merchants fell into line with the masters and made it possible to depend upon the authority of the employer for attendance in both classes of schools.

About 1873 state compulsory education began to develop and for 25 years grew very slowly in favor, but within the last 10 years nearly all the states of the Empire have adopted it. Hamburg and Bremen being free towns and having more independent political feeling than the states, have been slower to force attendance upon the boys and their masters.

The principle now used to get apprentices into the Hamburg schools is to interest the employer, consult him upon subject matter, bring the proposition before his union and allow the pressure upon the student to come from that side. How much the master and the union are consulted regarding the daily program has been already discussed. The master is expected to allow pay for all, or at least most, of the time used by the student in day classes.

Absences must be excused in writing by the master, as it is his time that is lost; only under special conditions are excuses from the parents accepted. Unexcused absence is reported at once to the master, and continued failure on his part to correct this fault, or if he is keeping boys out of school to do any other work, is considered sufficient cause for reporting him to his union, which at once brings pressure to bear upon him.

Truancy occurs very seldom. It is found only in the first year and usually during the three months in which the pupil is undergoing his trial period of work. Once thoroughly established in the system, a German boy very seldom thinks of breaking it.

Mention has been made of the exact and systematic method which Altona uses to secure her pupils and insure their regular attendance.

Every employer is compelled by law to notify the school within six days of a contract made with a new apprentice, and these names are listed for comparison. The rectors of all day schools send to the trade school director the names of all boys leaving their schools for any reason whatsoever, and this list compared with the first mentioned shows the absentees. The police are then notified and look up these people to ascertain why the boy is not at work. Parties moving from city to city must notify the police in each place; any party selling, renting or leasing houses, rooms or any living space to another must send the police the names and occupations of the parties who are to occupy the premises.

There is still another source of information. When a laborer's income is less than $750 yearly, he must take out insurance, and as apprentices never earn any such amount, the government insurance list contains all the new names.

Truancy is reported to the police and the offenders are brought into school by the regular officers. Parents sometimes refuse to send their children to night school, but this happens only among the most ignorant classes. It is punishable by a fine of $5 in the regular courts. Boys occasionally refuse entirely to attend school and are arrested and fined $2.50 for each offense; this never occurs except in the very beginning of the school year. In cases of misconduct or truancy, a teacher can order a boy under arrest for one hour and the director can so order him for six hours.

Absences other than truancy occur frequently in the beginning among the lower classes, but are infrequent after the first few weeks in the classes doing regular trade work. This corresponds exactly with the experience given for Hamburg. All absence for illness must be excused in writing either by the employer or parents; but absences for any other reason must be arranged for with the director beforehand. Absence not so excused may be treated as truancy if the director so desires. With these stringent rules it is unnecessary to appeal to the union as in Hamburg; but the unions are of great service to the Altona schools in other respects, as they are to the schools in Hamburg.

THE TRADE-UNION

In order to understand properly the trade-unions of Germany, it is necessary to go back to their very beginning. Whereas unions in the United States were started for the purpose of protecting the laboring man from oppression by the capitalist, the innung, or union, in Germany originated from a desire to protect the legitimate members and the populace from imposition by inferior workmen in the same trades. The union in this country is open to any workman of that trade, laborer, journeyman or master, and because the object of the union is equal rights for all from a business standpoint, the skill of the applicant is not a consideration of membership.

The German innung is open only to masters of the trade who by their skill have proved their eligibility to that title, and it is not, therefore, a trade-union as we employ the term. With the verein, which includes journeymen, and is slowly growing in Germany for purposes similar to our own trade-union objects, the trade schools have no relations at present. Formerly every journeyman had to present for approval his meisterstück, an example of his work, before he could become a master and join the union. The need of more labor gradually lowered the standard and nearly drove the practice out of use; the instruction of apprentices likewise became poorer and the pressure of rush work and the adoption of piecework lowered the time and quality of instruction until it became a serious matter. With the steadying of industrial conditions, instruction began to improve, higher quality of work and more time was demanded of the master for his apprentices, the meisterstück began to reappear in certain trades, and innungs again examined carefully their applicants for admission. Thus on April 1, 1909 the barbers union passed a law forbidding any barber in Hamburg from employing an apprentice until the barber had passed his meisterstück examination before the union. This is now the tendency of the unions in Hamburg.

The effect of this period of retrogression and the knowledge that piecework defeats the aims of apprenticeship to a great extent, has made a lasting impression upon the minds of the masters; their desire to prevent a return of the first and to provide an offset for the second, has made the innung a loyal champion of the trade school. More than 50 per cent of the masters are anxious that their apprentices attend the schools; those who are against it come mostly from the uneducated classes and oppose it simply from the point of time. Whether the master desires it or not, he is often forced by his union to allow his apprentices time for attending school, and in many cases he is willing, and when not willing is compelled, to pay the tuition himself. Something more will be said on this branch of the subject under the topic " Important Industrial Laws."

The union itself establishes monotechnic schools where those on piecework can obtain the general instruction needed; it joins willingly in aiding the public schools in advancing their courses; it works hand in hand with public trade schools and the masters are glad to arrange for such classroom instruction as their own schools can not offer. Indeed, even the semiprivate schools are frequently championed by these same employers. The union requires the master to give his apprentice certain personal instruction and time off for school; it requires the apprentice to attend school and to give certain hours of his evenings in addition to the time allowed him; it sets the journeyman's examination and through the Chamber of Commerce directs the meisterstück. It will be seen, therefore, that the trade schools have to deal with a body of experienced, trained, intelligent masters of trades, who are willing to devote a part of their time, money and brains to the support of the schools and to give consultation and advice upon the everyday working.

Not only do the schools have their advisory committees, made up of masters from the unions, who assist in the preparation of textbooks, pass judgment upon the practicability of examples and problems, and carefully follow the work in tradecraft, industrial economy and the like, to see that it is adapted to practical needs; but there are also visiting committees that go from class to class once or twice a year and criticize the work being done.

These committees are more active in Altona than in Hamburg and are at present devoting themselves entirely to the specific classes established by their unions. These visits are not the casual "look in" so often given by boards of supervision. For example, the committee of master butchers, consisting of five men, all practical butchers, visited the school during the winter and invited the writer to accompany them. They were given chairs in various parts of the room and remained 45 minutes in each recitation. They did not hesitate to interrupt the teacher and ask for more information from a student, to suggest further information than that given or even to correct the teacher on points of butchering. For instance, during the process of an example on sheep the instructor gave out a certain weight of wool and skin and an allowance for waste. One of the visitors immediately called attention to the fact that so much wool by weight would call for a heavier allowance for skin, and the weights for wool and skin would undoubtedly give 3 to 4 pounds more waste than the example called for. The committee agreed that this was so and the example was accordingly changed. At the close of the session these gentlemen went to a café, gathered around a table and for an hour and a half discussed what they had seen. The head teacher was present and was able to bring out any phase of the work desired.

In order that there be no misunderstanding regarding this matter, it must be understood that the butchers' classes, although part of the regular continuation school and held in the public trade school building, are more directly under the union supervision than most other classes. The union pays the salary and selects the head teacher and is therefore possibly more interested in the school than those unions that do not contribute so directly toward the school support and management.

GIRLS PUBLIC CONTINUATION SCHOOLS

So far as the general education of girls is concerned, their preparation for business, trades and shops is secured in special classes of the regular continuation schools, but receives much less attention than that devoted to similar education for men.

Some of these classes have already been mentioned, such as those in commercial branches, languages and special classes for wives and daughters of tradesmen; besides these there are a few classes for shopgirls, and practically nothing else. There are two or three semiprivate schools similar to the trade-union schools for men, where millinery and dressmaking or ladies' hairdressing may be learned, but these are always attached to a regular commercial shop and are not, strictly speaking, schools at all. We do not find entire buildings devoted to the instruction of women in the history, science, mathematics and drawing necessary for the various trades in which women are becoming the conspicuous workers; we do not find practice schools where girls can obtain practical instruction in shirtwaist making, skirt making, shopkeeping, and designing at night under instructors paid by the city or by the unions. All this is left to the private school almost exactly as it is in this country, and it is in this subject of continued education for girls that America has perhaps least to learn from Germany.

There are, however, three types of girls public schools in domestic arts now being conducted in Altona. One is a normal course for teachers of the subject; another a very excellent course for the children in the common schools, this course being also a practice school for the girls in the normal class; and the third and most interesting of all, a course for factory girls who come two evenings a week to a specially prepared room in the basement of a public building and are instructed in cooking and homemaking. This course is partially supported by donations, and on the evening of my visit was being inspected by a lady who was financiering entirely at her own expense a similar course for poor girls.

The instruction included plain, everyday cooking; simple chemistry of cooking; relative values of various kinds of foods; care of the kitchen, cooking utensils, stove and fires; and lessons on serving, dining room arrangement and menu.

A course very similar to this is given to the girls from the first, second, and to some from the third class of the common schools, in a building devoted entirely to this purpose. and situated adjacent to one of the large volkschulen. In addition to the usual work, the children prepare and eat their noonday meal in this school, wash and put away all the dishes, launder their own table linen, aprons and towels, and receive such general instruction as is indicated by the course laid out for the normal class. This is the practice school of the normal girls, who are the only assistants to the head of the department.

These girls receive a very thorough course beginning each day with a consideration of the menu card and the menu for the day, followed by a description and the actual preparation of the food, and lastly the cooking. During the time necessary for cooking, the teacher discusses the nourishing properties of the food, and its specific qualities and wholesomeness. When the meal is ready a table is laid to correspond with whatever occasion the menu was designed, and the food is eaten. Afterwards everything is cleaned and put in order. Besides cooking, the students are taught bed making, healthful methods of clothing, nursing the sick and care of children, special foods for the sick and for children, and household management.

The teacher believes that the work should be taught to the children in the common schools as class instruction and that the tasks should be so regulated that as far as possible all the students will acquire a high degree of proficiency. She most emphatically says, however, that it is not her chief aim to produce skill and knowledge in her pupils, but to train them as homemakers in the largest sense of the term. She considers that the first duty of the school is to teach virtue, order, patience, helpfulness, economy and cleanliness.

There is one class in the public continuation schools of Altona that is doing millinery, sewing, fancy needlework, woodcarving and burning much the same as that work is taught under manual training; but for the serious study of woman's work we must look to the girls private school of Hamburg.

GIRLS PRIVATE SCHOOL AT HAMBURG

This school is maintained under almost the exact conditions found in Pratt Institute, Brooklyn, or Mechanics Institute, Rochester. It is a private institution receiving no assistance from the city and located in a very substantial brick building purchased by means of an endowment.

The course of study includes German language and literature, French, English, writing, arithmetic, algebra and geometry, nature study and science, bookkeeping, housekeeping, housekeepers' accounts, kindergarten, history, geography, history of art, hygiene, civil government, handwork, trimming, millinery, washing, ironing, sewing machine practice, embroidery, drawnwork, drawing, pattern cutting, dressmaking, sewing, mending and knitting.

Each girl has her own separate program of work made out on entering and is assigned to one of the special departments into which the school is divided. There is the handworker school, upper and lower division, each requiring one-half year of work. In this department is done the actual handwork, excepting such as is purely artistic and comes under a department of its own. The regular school is another department, teaching the languages, science, and the theory required for the handworker school. There is also the kindergarten, nursery and governess school and another department: the commercial school, giving typewriting, stenography with correspondence and preparation for teaching the same. This second department prepares for the government examinations as private secretary, woman officers, court reporters and similar positions. The school of artistic design offers drawing, designs for needlework, lace making and embroidery patterns for cloths, ar[illegible] and tapestry, photographing, wood cutting and burning, engraving and a course for the preparation of drawing teachers. A special school for the preparation of teachers in the domestic [illegible]. There is done all needlework, cooking, sewing machine work, fine washing, table decoration and service and cookery chemistry, with the study of the pedagogy of each. A course for housewives assembles all the foregoing domestic subjects into a practical course without pedagogy and with very little theory, while a separate school for servants adds to cooking, housework, washing and ironing, the very important subjects of gardening, chicken raising, care of fowls and animals, sanitation and health and a course in the direction of underservants.

With the advent of compulsory education it is hoped to establish classes similar to those in the private school with more emphasis thrown on the industrial and factory side of the question and to open these classes to girls in the free public continuation schools.

CONTINUATION SCHOOLS IN SMALL PLACES

Not only are schools like the above restricted to cities, but even the commercial classes and girls continuation classes are found only in the larger places. Harburg, a city of over 60,000 inhabitants, has a fine brick building well equipped for its continuation school and classes for men in nearly all the subjects offered in Hamburg. Several of the illustrations given earlier in the report, especially the bakers, were taken from this school, and yet practically no provision whatever is made for the education of girls.

So far as the boy apprentices are concerned, in cities like Harburg and others ranging from 30,000 to 60,000 people, the trades represented in continuation classes will be almost as numerous as in the largest cities. Very naturally the location will determine what trades are to be provided for, and when for reasons of location and size some trade does not appear in the innungs, the schools are smaller by that trade class and consequently the number will not be fully equal to the number found in Berlin or Hamburg. The activities of the place, however, are as fully covered by the trade classes as in any city and the work is very largely the same.

When it is said that there are nearly as many trades in these schools, that does not mean nearly as many classes. The combined classes, where trades that are at all allied in any subject are put together, are now the most important ones. Those trades represented by one or two apprentices each, are grouped into classes where the general instruction is supplemented by a great deal of industrial teaching.

As a type of still smaller school may be mentioned the one in Blankenese, a village of about 5000, on Prussian soil, one-half hour's ride from Hamburg. This school is conducted only in the winter months and provides instruction only for men who are employed in the most important industries of the vicinity. The classes are largely made up of laborers unemployed at this season and of apprentices sent in by the more enlightened employers. No effort is made to force attendance or to provide especially for a large number of odd apprentices who might otherwise be induced to attend. With the coming of open weather and the beginning of farming and building, the school closes.

In places of this size the state of Prussia does not make continuation school attendance obligatory. In some places the province enacts a law reaching these smaller schools and in other places the "kreis," a still smaller division, has made attendance at its continuation schools compulsory; but many places like Blankenese do not come under either of these heads and the feeling is rapidly growing that the state should take some action to place them all on a similar compulsory footing.

ATTITUDE OF TRADESMEN AND APPRENTICES

Among the most interesting features of the entire study of industrial education were the conferences with people who were indirectly or not at all connected with the schools, in order to ascertain the general feeling along these lines. Two things were apparent at the outset; the people as a whole are believers in continuation school education whenever they are obliged to express an opinion for or against it, and the system has become such an accepted part of the German educational idea that it no more occurs to the ordinary citizen to doubt its value or criticize other than points of administration, than it occurs to a German to doubt the usefulness of common public schools. The masters believe in it strongly but they divide on the question of day and evening classes. Several of them declared positively that apprentices could do as good work in the evening as in the daytime and might much better be in school than running the streets. They affirmed that it was a waste of time and money to send the boys to school during part of their working hours, which encouraged a tendency to idle along the streets. The writer, however, observed that pupils, almost without exception, left the schools immediately upon the close of classes and hurried away either to homes or shops without any lingering groups. They were seldom seen to stop either in the school or on the street, and many of them used bicycles, going and coming in the least possible time. A barber in Altona complained of the time lost by his boys in attending the day classes but was eager to praise the work done in the practice school in the evening. An upholsterer in St Pauli said the boys were taken out of his shop at exactly the time of day he needed them most, but he was favorable to day classes if arranged to suit the convenience of the trade. Other masters maintained as firmly that the best work could not be done at night and that those who opposed the day classes really believed in them but did not wish to allow pay for the school hours. In Hamburg only a few employers have refused to send their men to day classes, although perhaps 40 per cent of them would rather have all evening work.

The parents questioned shared the same indifference previously mentioned as existing among the apprentices. There was very little opposition from them because of the cost. The tuition is often a tax on the master. Complaint was never made as to the material and books used by the students. In Hamburg there are many free scholarships for poor boys, where poverty is the only requirement for a scholarship and most of the text material is included in the tuition fee of the others. One father objected to the school because he thought the masters used it as a means of teaching a political philosophy favorable to their own ends; another was equally opposed because he said the masters paid less for their apprentices' work since they incurred the added expenses of trade education. Not one person, however, wished to abolish the schools. A few parents in Altona objected to compulsory education because their sons went to Hamburg where they attended the school of their own free will. Several of the employers resented compulsory education because they believed the student should be approached through his work and not by law. Others considered the law the easiest and most practical means and scouted the idea that the source of compulsion had any effect upon the industrial attitude of young apprentices.

Two members of the city council in Altona were opposed to the schools as they were being conducted, because of the cost, and one of them suggested that the schools might be combined, dividing much of the work of the continuation schools between the common schools and the middle schools, with a great saving of expense to the city. The school men meet this argument with the reply that the trade school approaches the entire educational problem from a standpoint absolutely different from that of the regular schools, and that to adopt common school methods or attach the teaching to any course not solely related to actual trade, would stultify the usefulness of the schools. Contrary to the repeated statement that the continuation schools were frequently fitting schools for more advanced courses, the director of the Royal machine building school in Altona stated that very few students of the trade schools ever entered his institution, and when they did their previous training was of very little value. On the other hand, the head trade school in Hamburg and also the school for the building trades have in their classes many journeymen who obtained their fitness for entrance in the regular continuation schools.

It was distinctly noticeable that graduates of continuation schools were always loyal to those schools and never questioned the value of the training they had received. In every instance the journeymen and masters who had been educated in these schools were strongly in favor of their continuance along the present lines; the masters were outspoken in their desire that their apprentices attend the schools, and in nearly every case where an employer was found ready to champion the extension of the scope and influence of trade schools even at increased cost, he was found to have received his own education in continuation schools. Some of the largest employers of labor, themselves educated in higher schools, took a similar stand.

STARTING A NEW SYSTEM OF CONTINUATION SCHOOLS

To reach those who are indifferent or opposed, the school authorities have definite systems of procedure. This opposition or indifference is a larger factor when new schools or new classes are to be formed than at any other time. For this reason Inspector Kasten believes that a new system of continuation schools should be started from the commercial side, with freewill attendance and a few classes having sessions only in the evening. Commercial classes cost less than trade classes, teachers are easier to find and less expensive and students are apt to be of a better class. These few classes should be well advertised, emphasizing the fact that the course includes nothing but practical work related directly to business affairs. Stress should also be laid upon the fact that the teacher is a practical business man who is in, or is capable of going into, the line of business taught and earning his living there, and upon the fact that the class is no part of a common school or a continuation of the work as done in common schools. Separate this course as far as possible from all connection with "school"; relate it ever to "work"; see that the teachers are competent, especially competent to open up the subject from the right viewpoint. If they are elementary teachers, let that be no part of their recommendation, but see that they are specially trained and have the "spirit" of a trade school and advertise this fact as important. Let it be known through the local papers and trade journals and by notices in the business houses and shops which are affected by the new classes. The following is a translation of such an advertisement:

Hamburg, March 11, 1909
Grosse allee 43

From the school inspector of the industrial schools

Your attention is called to a proposal of the Board of Retail Merchants submitted Oct. 8, 1908, to establish a continuation school for salesgirls. The following has been the result: the governing board of the trades schools has decided to run a continuation school for salesgirls beginning with the summer half-year. The course will be given in the Böskmann public school building and will start April 15th.

The following is a brief sketch of the organization: There shall be two divisions, lower and upper, each running for one-half year. The hours, four per week, are from 8 to 10 a. m. on Monday and Thursday for the lower division, and 8 to 10 a. m. Tuesday and Friday for the upper division. In order, however, to meet the wishes of various employers, it has been arranged that when sufficient girls in any one firm are registered, the lower division shall have a second part so that half of such girls may come Monday and Thursday and the other half Tuesday and Friday.

The work will be in the hands of entirely practical men acquainted with all the needs of the retail business.

Tuition is $1.50 per half-year and must be paid on registration. Registration will take place March 22, 23 and 24, from 6 to 8 p. m., in the commercial continuation school for girls, Koppel 98.

When registration is made by the firm, a list giving full names of all girls so registered is to be handed in. To each registered student is given a receipt and a school card; the latter is to be presented on the first day of instruction as evidence of enrolment.

All further information will be gladly supplied by the undersigned.

Respectfully,
A. Kasten

It will be observed that the employers were the suggesters of this course and that they were also consulted as to hours. The plan is at first to consult them upon all the details of the school and arrange to fit the practical demand. The inspector personally visits all the merchants effected, points out the course and its possibilities, requests suggestions and seeks their cooperation. The course of study at this time is especially referred to the merchants' committee and is always open to its suggestions.

Upon receiving the request from the retail merchants the inspector went before the Chamber of Commerce, interested their leaders and had a meeting called. He addressed the meeting, laid the plans before it for discussion and finally obtained its support. The various merchants agreed to send their girls to the school and signed their names, stating the number of shopgirls they were employing. The Chamber of Commerce reported this meeting to the continuation school board and the classes were soon in process of organization.

In starting a trade school the inspector first approaches the master of the trade-union and determines whether he will support such a school. He asks if the union would like to hold a meeting and have him address them and present the plan of work under consideration. After discussing various plans and times of instruction the master is left to talk the matter over with his union and if they are favorable, the meeting is called and the plans agreed upon. Any employers who were not at the meeting are visited in person and consulted as in the case cited above.

When it comes time for advertisements, they are written up as in the first case, only the stress is even more strongly laid upon the fact that a *tradesman* will have charge of the work, which will be related to the needs of everyday practice. To begin a class a teacher should be always sufficiently master of the trade to be classed as a tradesman and not a school teacher, and all relation to the word "school" should be kept in the background. It is unnecessary to more than mention that the teacher must be a strong and capable man.

[illegible] take [illegible] large [illegible] demand [illegible] equipment. [illegible] apparatus [illegible] that part of the apprentice [illegible] get in [illegible] established [illegible] important [illegible] the [illegible]

[illegible] lighting [illegible] the "class-hour" plan [illegible] per week, are twenty class- [illegible] recitations. The cost of such [illegible] the heating for twenty [illegible] will be such an amount per [illegible] teacher's salary is [illegible] reckoned by class-hours, and in [illegible] average [illegible] per class-hour. [illegible] reckoned only in their [illegible] materials used in drawing and painting classes and [illegible] easily be computed by class-hours multiplied [illegible] average number of pupils per class.

It is [illegible] point of greatest importance in starting an entirely new [illegible] to learn the amount of the demand for each class before it is provided and of the support of the employers before the class is determined upon. The most important point regarding equipment is to be sure of the need and usefulness of every piece of apparatus asked for and be prepared to state precisely what will be done with it and wherein it is valuable to the student.

MEETINGS FOR EDUCATIONAL DISCUSSION

This topic owes its right of admission into this report to the close relationship existing between general educational thought in Germany and vocational training. Public meetings called by some important political or educational officer or board are frequently held for the purpose of ascertaining the feeling of the people on certain topics and with an idea of creating or influencing public sentiment in favor of further improvement. These meetings are largely attended and debate is usually spirited, often heated; they not frequently last four or five hours. Industrial education is almost invariably one of the main topics, if not the principal issue, and the interest manifested in any trade school problem is very keen. As a specific example of what one of these meetings is like, the following, which was an advertisement in the form of handbills and newspaper notices, is here inserted:

Altona in January 1909

On Friday the 15 Jan., 1909, 8 o'clock p. m., in the assembly hall of the State Museum will be held a meeting for the consideration of the descriptions of a few methods of further advancing our schools.

Lecture — Herr Stadtschulrat Wagner on the " Mannheimer System "
Lecture — Herr Fortbildungsschuldirektor Trenkner on " The Purpose and Goal of the Trade Continuation School "
Lecture — Herr Mittelschulrektor Schmarje on " The Purpose and Goal of the Commercial Continuation School "

Following these lectures a general discussion will take place. To this meeting have been most respectfully invited:

Senator Dr Harbeck
Chairman of the School of Deputation
Chairman of the Board of Continuation Trade Schools
Chairman of the Board of Continuation Commercial Schools

The meeting opened at 8.15 p. m. with Dr Harbeck in the chair. There were present members of the city council, school board, committees of commercial and trade continuation school boards, direktors of higher schools, rektors of middle and lower schools, teachers, master workmen, heads of different trade-unions, business men, mechanics and tradesmen. No women were present. Three main questions were considered: " The Mannheimer System of Differentiated Schools "; " The advisability of extending the trade schools or curtailing them to save cost "; and " The Commercial School as a Day School."

Schulrat Wagner strongly urged the adpotion of the Mannheimer system in Altona. It relates only to common school work, divides grades into subdivisions according to the ability of various groups of children and adds a help school for weak-minded children. All children start alike in the first grade. As soon as possible they are divided, the brightest going into division I, the next group into division II doing work slightly less advanced, and the remainder into division III which starts the work at the very beginning and receives the new children. Children may be advanced from one division to another if they improve later on. Two divisions are usually in one room, but whenever possible only one in a room. Schools should have records of each child's environment; full reports should be made; medical inspection should determine the feeble-minded candidates for the help school. The speaker presented abundant practical and pedagogical argument to support his position and favorable action was taken by the meeting.

Direktor Trenkner said in part that it was not alone the aim of the continuation school to give special trade instruction, but some general education as well. He reasoned that most children in the volkschulen are too young to appreciate their advantages; they come to trade schools still too young and with their minds on other things. They develop with age, by contact with men, in their relation to trade; they see the need for more education and their minds become centered upon a definite object. Now, he argues, is the proper time to introduce some general education and the continuation trade schools should be prepared to do it. (A literal translation of most of Direktor Trenkner's speech will be found at the close of this report.)

The remarks as stated above were heartily approved by all the school men present, many of the masters and most of the business men. They were opposed by two city officials who objected to the cost and thought the common schools should be so combined as to give all the general education required and leave only the technical to the vocational institutions. Several important business men, a few trade-union men and nearly every tradesman present who had himself been educated in the evening classes, indorsed Dr Trenkner regardless of cost. A second recommendation, that of more day and less evening classes, because apprentices were tired at night, was supported by nearly all the school men, by a few masters, and by a large number of merchants and mechanics who had studied the boys' conditions in the evening. It was opposed by two masters on the ground of lost time and bad street influences upon idle boys at night. The meeting agreed that the occupation determined the fitness for evening work and some day classes were desirable.

The most important recommendation was for a vorschule for boys coming from class III of the day schools who needed more common school education; a second division for apprentices from classes II and I with less general education and specific trade work added; and a third division for machine-builders and those engaged in higher designing in artistic trades. Dr Trenkner supported his request for class III by saying that a large number of boys were anxious to attend the machinenbauschule and kunstgewerbeschule but were prevented by the cost. They came to him and, perhaps, by receiving initial instruction could later on attend the other schools.

He urged them to go whenever they could. This was opposed by the same city officials because of the cost and the direktor of the state machine building school said that very few boys came to him from the trade schools and what they had previously learned was of little use to them.

Stricter compulsory laws for trade schools were opposed by some because the proximity of Hamburg was drawing boys to its elective schools, and it was argued that the average attendance in Hamburg was better than in Altona. Teachers and various others supported firmer laws, claiming that 50 per cent of the pupils would not attend regularly unless compelled.

The trade workers themselves seemed always to favor any proposition for the advancement of the schools or enforcement of laws.

Direktor Schmarje of the commercial school claimed that education in his school must be broader than in the trade school because one business man dealt with more phases of world activity than a trade worker would ever meet. Everything pertaining to business was his field, general as well as specific occupations. The business boy must go further in all the common branches than the trade apprentice and should never come at night because he sits indoors all day. There was no opposition to this report.

Interest in the entire meeting was great; debates were general; and a call for another meeting was made to further discuss the appropriations needed. The hall was practically filled, about four hundred persons being present. The meeting lasted four hours, closing a few minutes after midnight.

From the proportion of time in this meeting devoted to continuation school topics, from the class and size of the audience and the hour of adjournment, some idea may be drawn of the interest the German citizen feels in his trade schools.

GENERAL GOVERNMENT OF EDUCATIONAL INSTITUTIONS

It may be of interest to know how the educational institutions in Germany are divided for government by the state. The volkschule or common school, the mittelschule or middle school, and the realschule or advanced middle school leading to business have already been touched upon. In addition to these there is the oberrea'schule, a school of nine years' instruction besides its vorschule of three years' primary work, giving modern language, science, history etc. preparatory to business; the realgymnasium, Latin and modern more stress on the classical side; and the gymnasium, the Latin and Greek classical school. There are also classes of schools governed directly by the national government and not subject to local control, such as the königlische machinenbauschule, navigationschule, and lastly the hochschule and technischehochschule, which are really universities.

The common schools and middle schools are governed as follows, beginning with the rektor or lowest executive:

1 Rektor, principal
2 Schulrat, similar to city superintendent
3 Kuratorium, board for business management only
4 Regierungs schulrat for common schools, superintendent over a subdivision of the province. He is a member of
5 The provincial schulkollegium, board of education for the province
6. Kultus ministerium, state
  (a) department of common schools
  (b) vortragenderrate or special advisors to the department, and hülfsarbeiter, who have charge of the subdivisions.

Of the above, 1, 2 and 3 for the city, 4 and 5 for the province, and 6 for the state.

The other schools are shown in the following table:

Paid by Altona	Paid by Prussia	Endowed
1 Stadtisch	Königlisch	Stifts
2 Gymnasium	Realgymnasium	Oberrealschule
3 Direktor	Direktor	Direktor
4 Kuratorium der höherlehraustalten City board	Provincial schulrat für höherschulen Superintendent in the province	Board privately elected
5 Provincial schulrat für höherschulen	Provincial schulkollegium	Provincial schulrat
6 Provincial schulkollegium	Kultus minister	Kultus minister
7 Kultus minister Division for higher schools		

Item 1 gives the auspices under which the school was founded and is conducted. Item 2 names the class of school. Items 3 and 4 give governing authorities.

As this topic is only incidental to the general subject it is not necessary to go further into detail, as the above gives a fairly good idea of the multiplicity of government.

IMPORTANT INDUSTRIAL LAWS

There are a few noteworthy laws concerning industry, industrial workers and industrial education which have been enacted in various parts of the German Empire and are of interest in suggesting what may be done along the line of governmental control.

It is unnecessary to give any large number of these laws, as it is impossible to draw this information first-hand, and for those who desire to obtain more information, the consular reports cover the field fully. The laws here given are selected as types of legislation that are likely to interest America in the near future.

In all of the German states, common school attendance is compulsory up to fourteen years of age, excepting those over thirteen years who have completed the common school; and confirmation in the church is necessary for graduation from the common school.

In most of the German states, attendance at the continuation trade school is compulsory for all children who enter trades and for all who leave the common schools and do not go into at least a nine-year course higher school or its equivalent in private tutoring. In Prussia, compulsory attendance upon continuation schools is left to the cities, the province or the smaller political divisions of the province.

In a few cities, attendance upon continuation schools is optional.

In many cities, attendance upon continuation schools is forced by laws passed by the unions.

The following laws, except no. 1, which is a national law, are found in various parts of the Empire:

1 A master must allow his apprentice six hours a week with pay, until he is eighteen years of age, if he uses this time to attend a continuation school.

2 By ordinance of a district council or a wider communal body, attendance at a continuation school may be made compulsory up to eighteen years of age.

3 Regulations may be passed to secure attendance and define the duties of parents and employers.

4 A master must send his apprentices to the continuation school for a fixed number of hours per week.

5 A master must pay the tuition of his apprentices in the continuation schools and may deduct the same from his wages.

5*a* No master shall hire and instruct an apprentice until he has himself passed his master's examination.

6 Every employer must, within six days after hiring, notify the superintendent of continuation schools regarding a new apprentice.

7 The trial period of an apprentice shall not exceed three months.

8 Attendance, curriculums and minimum requirement shall be set by the state; the local authorities shall establish the schools.

9 The community shall furnish quarters, heat and light. State aid shall depend upon the needs of the community.

10 No day school teacher shall teach more than ten hours per week in evening schools.

11 Teachers in industrial schools shall take special instruction in drawing and commercial branches for six weeks at the expense of the state.

12 The principal of each public school shall notify the police of every child leaving his school.

13 Children under thirteen years of age can not be employed, and not from thirteen to fourteen unless they have completed the common school.

14 Children over fourteen years of age may be employed but not exceeding ten hours a day, on Sunday, a holiday nor during religious observance.

15 The midday pause shall be at least one hour unless the working day is eight hours or less.

16 Children shall not be employed in certain specific trades determined by law.

17 Women shall not be employed between 8.30 p. m. and 5.30 a. m., or after 5.30 p. m. on Saturday and the days preceding holidays.

18 Permission must be obtained to start a factory, and special permission in cases where it might prove a public nuisance.

19 Factories shall be inspected by government inspectors; if women are employed, women inspectors may be appointed, and the factories must be inspected every six months.

20 The inspectors of the government shall have the right to enter private homes if the apprentices are regularly employed therein.

21 Every factory must have and post in a conspicuous place a set of rules showing hours of work, intervals for meals, time and manner of paying wages, conditions and length of time in serving notice for terminating employment, and punishments.

22 Wages must be paid in currency and not on Sunday.

23 It is the duty of the state to protect life, health and morality, but to do so in a manner that does not hamper industrial enterprise.

24 Whenever the income of any workman is less than $500 per year, he must take out state sick insurance.

25 When the income of any workman is less than $750 per year, he must take out invalid and life insurance.

26 Attendance at the continuation school shall be compulsory for two years of at least two hours per week, or for four hours per week for the winter months.

27 Every city must contain at least one continuation school, unless excused by proper authority for sufficient reasons. Boys must attend two years; girls one year.

28 The annual subsidy of the government paid to continuation schools shall be conditional upon compulsory attendance.

29 Rural schools may be under the Department of Agriculture or the Department of the Interior.

It may be said in general that the laws in Germany have been made with an equal desire to protect the worker, especially the women and children, and to refrain from narrow or excessive legislation that tends to obstruct the development of national industries. These laws are quite generally enforced, but there are certain industries which are permitted to relax from the strict letter of the law because its enforcement would materially hamper the development of these lines of trade. It must be said in all justice that the government tendency is to favor development at the expense of the law provided the conditions are reasonably complied with and no strong opposition arises. Such strict supervision as, for example, is maintained in Switzerland, is not popular with the Germans.

FUTURE OF THE GERMAN TRADE SCHOOLS

It would appear rather presumptuous for an American to predict the future of a system of German schools, if it were not that certain tendencies in the development of these schools are so plainly to be seen. These tendencies may be grouped under four headings: (1) relation to industry; (2) aim and ideal; (3) compulsory attendance; and (4) shops and classes.

1 There has long been a feeling in Germany that the first law of the land, after provision against invasion, is to provide for the development of its industries. Every civic and social statute has been weighed with regard to the effect in fostering or hindering industrial growth. During those years when Germany was struggling slowly and against great opposition toward a position of industrial eminence, many wholesome laws were modified or delayed in pass-

ing, and many existing statutes were indifferently carried out, because even the slight restrictions which they imposed would be sufficient to check the progress of, or even break up entirely, some line of manufacture which could only afford the cheapest buildings and machinery, and demanded long hours of labor to keep any figures on the credit side of its balance sheet. The industrial school, as far as its establishment and maintenance promoted the growth of industry, was very popular, but whenever the laws relating to schools, like those regarding child labor, ventilation in workshops, and safety devices, threatened the commercial progress in any way, the school was made to feel that it must give way to the greater demand.

The time has passed when German industries need to be carefully protected. The spirit of the people has changed and is changing in regard to those laws that should be enacted or should be more rigidly enforced. The tendency is not only to enforce the general laws relating to labor but also such specific laws as those relating to day classes in schools, shorter working hours on school days for those in evening classes, employment of the young, and so on. In a word, the relation between the school and the industry has changed so that it is the industry now that must suffer temporarily from the enforcement of laws which will work through the schools and result in benefit to both.

2 The aim of the trade school has always been to produce efficiency, to turn out students capable of doing some specific thing well. Until a few years ago this was its ideal as well as its aim, but today many German continuation and trade schools have raised their ideal to the development of more broadley educated and more patriotic citizens, keeping the aim as before. Demands for vorschulen are being made, such preparatory courses as are often attached to the higher types of day schools, strictly intellectual and even cultural subjects appear from time to time on the programs, and although as yet everything is related as closely as possible to the trades, still many industrial school men are outspoken in their belief that these schools have a higher mission than the mere making of mechanics. This subject has provoked general discussion and the men who are at the head of the larger systems of industrial schools are themselves better educated and broader minded than their predecessors of a generation ago, due to an almost unconsciously increasing demand for a higher type of leaders.

3 Compulsory attendance upon common schools up to the fourteenth year of age, and continued compulsory attendance in trade

schools for three or four years additional throughout the German Empire, is only a matter of time. Wherever compulsory education has been tried for continuation schools it has succeeded so far that no effort has been made to abolish it. The states that have compulsory education are in the large majority and are willing that the central government shall take steps in the matter. In Prussia, where it is a local option, attendance at nearly all of the schools is compulsory and, for financial reasons, the state has almost the power to force it upon the others. The school men are practically united in their desire for forced attendance and a state law to that effect is confidently expected. The few cities like Hamburg which have voluntary trade schools could not hold out against the pressure for a national law even if they refused to pass such a law for themselves, but in fact the educators of Hamburg are anxious for compulsory attendance, confidently expect it, and many employers favor such action by the city.

4 There are three types of trade schools, namely, a school with evening classes and no shops, or with trade-union shops affiliated, dependent upon an apprenticeship system; a school of evening classes and day classes for those who can not do good work at night, and with shops for supplementing the work of apprentices in regular shops, such as those doing piecework; a school with all day classes, fully equipped shops to turn out journeymen and not depend upon an apprenticeship system. Of these three types, the second is the popular German trade school of the future. The simple continuation school running at night in public school buildings has served the country well and allowed the growth to extend into small communities where the cost prohibited further equipment. The demand today, however, is turning very decidedly toward better schools. Teachers are requesting day classes in certain subjects and trades and these classes are being added. One shop after another is appearing in the school, especially in the artistic trades, and more and more supplementary shopwork is being added. On the other hand, the evening classes are not being abandoned except by a few indoor apprentices who can not work at night. The German is loyal to his apprenticeship system, and while willing to grant certain daytime classes, he has no intention of allowing the work to become all day work or of withdrawing the apprentice from the field of active labor until he is declared a journeyman. He is growing to see the wisdom of supplementary workshop instruction in school, but refuses to believe that it is best for an apprentice to learn the fundamentals of his trade in any but

a regular commercial shop. He will not adopt the third type of school, found largely in France, as a national industrial school for Germany.

It appears therefore that the future German trade school will be one having many evening and some day classes, supplementary shops, an apprenticeship system; that it will have a practical aim and a somewhat more cultural ideal; that its attendance will be compulsory, and this and all the other laws of education and child labor will be more rigidly enforced for the good of the worker and the school.

ADAPTING TRADE SCHOOLS TO AMERICA

The same differences in racial characteristics that make it difficult for one country to successfully transplant the school system of another, make it similarly difficult for the citizen of one nation to judge of the suitableness or unsuitableness of various foreign educational phases and to forecast correctly which can and which can not be successfully adopted in his own country. It is not, however, too much to expect that certain distinctive features will stand out above the others as desirable, while others appear totally unfit for the conditions incident upon such adoption. This is true in Germany, and only these very evident features are considered in this conclusion of the report.

The more definite and practical difficulties may be first considered. As has been said before, all the trade schools of Germany may be classified in three groups. First, those without shops, holding practically all of their classes at night, with the avowed intention of offering only the classwork necessary to supplement the shopwork which student apprentices are receiving daily at their regular trade; second, a continuation of the above with supplementary shopwork given in the school shops by teachers who are practical workers and members of the union and whose business is to offer that part of the practical work that a student can not get in his ordinary labor; third, a school providing all the theory and all the shopwork within itself and graduating trained journeymen.

The question is, Do we need all three systems and can we establish them efficiently?

The first class of schools is naturally the easiest and the least expensive to establish; it does not require shops or additional buildings and it could meet with no opposition from the labor unions. Its night classes would be of incalculable value to certain classes of pupils, and, especially at first, to a vast army of young workers who have recently left the public schools. As a national industrial system, however, it is inalienably connected with a national apprenticeship system, an apprenticeship whose time and scope shall be of governmental concern; such a system we have not and are not likely to have. Without a uniform apprenticeship system as a base this first type of school would grow in and benefit certain localities, dependent upon the industries and farsightedness of the employers; but its growth would be ever sporadic.

Much of the same reasoning applies to the second group. This type of school depends also upon a permanent apprenticeship system for its stability, although it is less dependent upon a governmental system than is the first class, because good shops of themselves would attract pupils, give practicability to the work, call for journeymen instructors and enable the school to adapt itself more readily to the needs of pupils coming from inefficient and inadequate shops and from incompetent or indifferent masters. The best school shops of Europe, however, are either directly or indirectly under the unions. They are either established and conducted entirely by the masters or are under a committee, appointed by the union, which is consulted upon every point, reviews the courses of study, visits the classes and aids in the direction of even municipal schools. Experience has shown that only by some such cooperation from practical men can the highest ideal of industrial instruction be developed, and the more correlation there is between the shopwork outside and that in the school, the greater the need of such cooperation and the more skill and time are required to articulate the whole properly. This system is therefore more or less dependent upon a union or upon an association of masters or employers. The difficulties confronting this are evident.

Unions of workmen have always arisen as a protection against some form of danger. In Germany the primary danger was the encroachment of inefficient and incompetent men upon the regular trades. The object was to insure efficiency in the masters, to set an examination and to restrict the instruction of apprentices to qualified masters. This very object brought about a union of masters, eligibility depending upon skill, irrespective of whether the members were employers or employees, and such a union is bound for its own advancement to take an active interest in the instruction of its apprentices. The issue in America was labor against capital; the union started for protection of worker; eligibility meant only that one must be an employee; master and journeymen stood together as employees and apart if one employed the other. There was no necessity for the protection of skill: the number of employers who were themselves skilled workmen grew ever less and less; today they are separated as the man who hires and he who is hired. A union of masters does not mean a union of employers: an association of employers does not necessarily mean a union of skilled workers; a labor union means all who work for others.

Such a union of masters as is found in Germany does not exist here. The leaders of our labor unions are intelligent, farsighted men not opposed to industrial education, but the very exigencies of their office prevent them from taking the aggressive, personal interest in education that the German feels obliged to assume. It is entirely possible to have a committee of practical men connected with each trade school, but such a committee could not be all employers or the unions would naturally object; it could not be all master mechanics or a great class of employers would be unrepresented; so it must be both masters and employers, which means that its influence must be necessarily local and that its various branches could not be united into a union of sufficient proportions to form the stable groundwork of a national system of education.

The third class of schools would most assuredly need such a local committee and it would be well for these schools if they could have a committee affilitated with a union as in Germany: but they can get along without such a committee better than either of the other classes. The fact that their apprentices are not connected with outside shops removes the necessity for this articulation; the fact that they would come into such a school at an early age — thirteen or fourteen — and remain as public school pupils, removes some of the necessary affiliation with the labor unions; and since each school gives its own complete apprenticeship there is no necessity for a national apprenticeship system. The local committees could work independently if necessary, although meetings and associations throughout the state would largely increase their efficiency. There are, however, at least three points of difficulty in this last type of school to which the other two are not subjected. It is the most costly of them all, shops and laboratories multiplying the expense very rapidly and teachers qualified for this work being scarce and expensive. It would require a remodeling of our public school system so as to advance the pupils into the trade school from a grade lower than the eighth, a change advocated today by many educators for conserving time, and one that would produce a saving in expense which would partly offset the increase for trade schools. If the pupil enters from the sixth grade and pursues a four-year course as a minimum and a six-year course as a maximum, it means the withdrawal of apprentices from the field of labor for at least two years after they are qualified, to a certain extent, to be actual producers.

The first of these is to be met by a slow and healthy growth, demands for one equipment at a time, and a disposition to allow the value of each step to manifest itself to the community before additional funds are called for.

It has already been pointed out that none but the largest and wealthiest communities should start with handsome buildings and expensive equipment. American models from which to draw are very few; whatever we have already adopted is in the nascent stage; practical results are determined as yet by local perspective only, and the most promising programs are undergoing continual change. Homemade models, basement laboratories, and secondhand buildings have marked the beginnings of most of the celebrated European trade schools and it is this spirit that will work most successfully in our country in producing a public sentiment that will provide the necessary money.

The second objection requires rather the overcoming of inertia in the public mind than the surmounting of material obstacles. Our school system now naturally divides itself after the eighth grade. This branching of the ways must be made to occur after the sixth or seventh grade so that the pupil going to the trade school may begin his practical education before he has finished the common branches so necessary to the same, and before he has joined the 80 per cent that give up school entirely in their search for more concrete instruction.

The third difficulty presents two phases, the personal and the economic. The student in the apprenticeship school is nearly, or entirely, self-supporting during his period of education, whereas the student in the third type of school is earning nothing. This is the strongest argument for the establishment of some schools of the first and second class no matter into what the general trade school may develop. Moreover, it should be possible for advanced students in a trade school to sell their work and retain the difference between the cost of material and the selling price. Any objection to this from outside producers could be met with the statement that the skilled instructors working in the school and not producing could and would produce nearly as much as the pupils if the school were not occupying their time, especially as the output of such schools will generally be too small to be of economic importance to the country as a whole. Students working intensely in a trade school should master their trade in less time than under the part-time system and coming earlier into the journeymen's field will make up in advanced wages for some or all of the loss during the school years.

As to the general economic effect, the sudden and universal introduction of these schools would bring a stringency in unskilled and apprentice labor and a consequent rise in wages. Even this would readjust itself in a few years with the influx of well-trained apprentices into the trades in place of the untrained material of today, a resulting increase in production and falling in price, provided other conditions remain the same. But the introduction of these schools will be neither sudden nor universal and it is doubtful if they will multiply rapidly enough to effect the supply of laborers.

It would seem, therefore, that this third system of schools might be adapted to American needs, especially as it is the avowed aim of our free education to keep the child in school and out of daily labor until he has reached the completion of the education he started out to obtain.

This leads us naturally to the larger differences and larger difficulties. The main object of the German trade school is to turn out a finished mechanic; the secondary object is to produce a soldier and at the same time a desirable citizen of a limited monarchy based upon military traditions and supremacy. The primary object of the American trade school should be to retain and educate into efficient and desirable citizens of a republic the 80 per cent of children now leaving before the close of their grammar school years. A very clear, certain and practical, but secondary, object is to produce skilled mechanics. The German apprentice is made to feel that he is no longer in school but in real life and trade; he is not being educated but trained. The American student should feel that skillful training is education, that real life and trade should permeate the school, that he is not only in school being educated as surely and as freely as his playmates in the classical school, but that his education is just as honorable, just as serious a matter of consideration and just as efficient a road to respect as any other education.

Although the common schools of Germany include religion in their regular course of study and many of the volkschulen and mittelschulen devote special attention to moral and cultural growth, the trade schools generally ignore these subjects entirely. Every subject is focused upon the daily needs of the trade and the student is impressed with the fact that the church and the day school are expected to have completed these branches except as they relate to personal honesty and the duties of citizenship.

It is the first duty of every American school, however, to turn out well-rounded and not one-sided young men and women, and well-rounded young men and women are not produced by giving them a few years in the Sunday school, a few years in the classical school and then a few years in the specific trade school, leaving each successive influence to join the natural forgetfulness of youth in obliterating whatever has gone before. The childs' period of receptivity to moral and cultural subjects usually precedes his interest in manual instruction by several years, but it extends far into, if not entirely through, his industrial school days, and any trade school that deliberately omits this side of its program and neglects to keep alive at least whatever ethical and cultural instincts its pupils bring with them, has a very narrow ideal.

As a general rule, skill is a more important asset in Germany than education and initiative, and the trade schools are influenced accordingly. The German boy lives in an atmosphere where orders come from above and the surest way to success is to possess the skill to carry them out without possessing a desire to criticize or improve upon the methods by which this is accomplished. The political and economic philosophy of the country tends to create a citizenship of painstaking executors of directions and to stifle initiative and inventive genius in the laboring man.

To the American boy education, initiative and self-reliance means everything, and whereas the introduction into our industries of a more highly skilled, more exactly obedient and less critical body of workers would be a very desirable thing, the American trade school must accomplish it by seeking out and avoiding those characteristics of foreign schools that would stifle the independence and ambition of the American boy.

Temperament must also enter into our consideration. Although extremely excitable on occasion, the German is usually slower, more phlegmatic and more persevering than the American. He is willing to work more entirely from method and less from reason and with a narrower though often more definite, outlook that would answer for this country.

This national principle of exacting the value of skill coupled with the national trait of patient endeavor has made the modern system of German economic progress possible and successful. Germany has risen to its present preeminence in world trade by educating its people [illegible] defined economic ideal, the highest aim being to make each worker a master within his own domain and thus to elevate the efficiency of each layer by itself. This has promoted the [illegible] skill and has graded the army of workmen much as Germany grades her army of soldiers, but it has too many points in common with the caste system of India to make it popular or effective in the United States.

America, on the other hand, has achieved success by the power of its youth to break through stratum after stratum until the plowboy becomes a general or the canal driver a president. Two of the evils, at least, arising from this are that the canal driver in his hurry to become president forgets the necessity of learning to be a first-class canal driver, and in his haste to break through the layers, has neither the time nor the desire to master any one thing; or else he fixes his attention so closely upon the requirements for president and develops such a devotion for them that he fails to note the dignity of honest canal driving and soon holds manual labor as undesirable, if not in actual contempt.

If, without killing the ambition to become president of some honest and honorable organization, political or economic, we can inject into our education that part of the German training that arouses a desire to acquire skill and mastery over the business immediately at hand and a patience and willingness to work and strive for success, we shall indeed have achieved what no other country has yet fully accomplished.

It grows ever more clear that the American school must be distinctly a school for America. It must adopt from Europe the sentiment of national organization and national recognition; it must adopt also practical methods, close relationship between work and school, cultivation of perseverance and skill, and a willingness to work with the hands; it must add to these a broader education and initiative, an ideal as well as a practical aim, a spirit of tolerance and respect for labor, and keep alive the ethical and the cultural as far as it is possible to do so.

It must de divorced from direct dependence upon an apprenticeship system or a trade-union. It must teach certain basic principles and at the same time be elastic enough to admit of special features wherever a community needs them. And, lastly, it must foster the spirit of American freedom of declaring the democracy of politics, economics and education. No pattern exclusively of our own making will fit these conditions; no pattern from Europe can be imported entire and so cut as to fit our ideal. We may borrow our metal from Germany and smelt it in the forges of France, but it must be cast in an American mold.

APPENDIX

DIRECTOR TRENKNER'S LECTURE

The question of the need of industrial schools is a subject no longer under discussion, as it is conceded by those who know anything of present day conditions.

The Altona school was founded in 1801 as a Sunday school and has stood a practical test. Its development may be divided into three different steps or periods: (1) beginning without any demand by law, its establishment was due to the efforts of a few farseeing, energetic, practical men. This period lasted until the establishment in 1869 of the German ordinance for industrial schools under the control of labor unions and other trade bodies or under associations established for the express purpose of looking after such instruction. (2) The second period extended to 1890. During this time the community began to interest itself in the school. (3) The first great advancement came when, at the close of the last century, the city and community together took up the question of caring for the youth after the regular school age. In this period came the erection and establishment of the teaching institutions which remain today.

The continuation school, therefore, is a product of historical development from actual need and not an accidental or arbitrary creation of later times; it has a full right to existence and a place in the history of culture. That it has stood the test of time and adapted itself to changes and needs and growth, proves that it was the product of a real need.

The continuation schools in Prussia are under the Ministry of Commerce and Labor, and their common aim, as laid down by that body, is a twofold one: first, the elevation of the moral strength of the student, and, second, the furthering of his trade ability. The continuation and common schools have, to a great extent, the same moral aim and methods, but in the furthering of the trade ability of the student, are quite different both as to aim and method.

A student in a continuation school differs in intellect, feeling and will from a common school student. His whole personality is ruled by his calling, whether he is to be a skilled or a common laborer. The new ideas which he has gotten from his calling are fresh and strong and overrule all former ones. The center of intellectual life is changed from that of a child and his highest interest is in his calling because it is of his own choosing. It is his life's work, his main idea, and gathers to itself all of his thoughts and attention; and the work of the school would produce poor results if this idea were not always first in the teacher's mind, that is, used in examples and lessons. All instruction must be related to the calling in question but there must be new adaptation of subject matter and new methods to keep up interest. The subjects and plans of the common school must not be repeated.

The continuation school must be a one-trade school, or a school for special meetings, as far as it can, or it loses its right to existence. On account of the limited number of hours it can not concern itself with a general education but must be confined to thoroughness within narrower limits. It must be a one-trade school, as far as possible, without losing its main object; must be organized and carried on according to the ground principles of the various trades. This is more difficult for the general continuation schools than for the commercial continuation schools whose students all have one general object. The general school must have a large number of divisions and a large number of different teaching plans to accommodate all of its students.

There are three divisions in the Altona continuation school, viz: (1) the general continuation school for all boys who are not learning any special trade; (2) the elementary division of six classes for less capable and undeveloped students; (3) the one-trade continuation school for apprentices.

The general continuation school and the division for unskilled workers, common laborers, messenger boys, and others has thirty classes and about one thousand students and is housed in three of the common school buildings. Each class has four hours weekly in the morning, or afternoon, or from seven to nine in the evening, according to the wishes of the employers. As far as possible the work here relates to the business of the student, for example, there is a three-class division for messenger boys; the same for the milk boys; a six-class division for workers in large factories; a class for hotel boys, and several others.

To illustrate that even in classes for unskilled laborers the instruction is based upon the practical need of the student, the following teaching plan for messenger boys is given. They are taught all traffic conditions of the home city: post, railroad, telegraph and telephone methods, street and street car ordinances, and plans of direction. They practise the filling out of all kinds of traffic formulas and the writing of bills and receipts. They are instructed in banking and money methods, in accurate addition of columns of figures and paying out of money, and in home geography so that they can give information and direction to strangers.

In the elementary division the least attention is paid to the calling of the student and the teaching plan is patterned after that of the common school. This is because the students have not yet completed the work of that school and therefore reading, writing and arithmetic must be taken up by simple methods.

In the apprentices' division the highest degree of attention is paid to the calling and to this end, as far as possible, they are divided into classes for special callings or trades. Besides the fifty-six classes in drawing, there are seventy one-trade classes — three for bakers, three for barbers, six for masons, five for tinkers, three for painters, eleven for machine builders, eight for locksmiths, two for typesetters, two for upholsterers and paperhangers, five for cabinetmakers, two each for tobacco apprentices, butchers, electrical workers and skilled mechanics, one each for tailors, furriers, druggists, waiters, confectioners, and coppersmiths. In some trades, as glazier, potter, and shoemaker, there are trade group classes, putting together trades in which the instruction is similar because there are not enough students in each trade for separate classes; but each of these boys has drawing for his own peculiar trade.

The school has also two full classes for commercial apprentices who ought to go to the commercial continuation school, and who are urged to do so by director and teachers, but because of parents, or some other reason, do not. They can not be compelled to, for the commercial continuation school is not obligatory; therefore, if they will not seek a better opportunity, the continuation school must provide for them.

Besides the regular teaching plans there are thirty different syllabuses for the different divisions of trades. These plans can only be made out with the help of men from the practical workshops, especially the master handworkers who have also helped with practical advice in the preparation of trade textbooks. Even though the teaching plan has been approved by the Ministry, still the school holds itself ready to make any needed improvements so that the work shall meet more and more the practical needs. To this end for each trade division there is a trade school committee of five men from that particular trade or calling. This committee visits the school, hears the work and afterwards offers suggestions and valuable advice to the director and teachers.

To advance the ability of the student in his practical work the instructors seek to ground him in all the principles relating to the knowledge of raw material, tools and implements. Arithmetic, drawing and writing are taught from the most practical standpoint. Even more important than all these is the practical work of the student himself, for he would not be employed, no matter how much theoretical teaching he had had, if he could not work well at his own trade. For this purpose the actual workshop comes into the line of teaching, for only in such a shop can the practical work be well done. Only in the actual work of the trade will occur all the incidentals and possibilities of everyday use. The school workshop can not therefore take the place of the regular shop but can only be used as a side issue or as a means of broadening the teaching of the regular shop. Only such things should be taught in the school workshop as the boy can not learn in the regular shop and yet are necessary to make him a practical, all-around master of his trade. The continuation school does this work in a small measure with painters, confectioners, masons, carpenters, waiters, upholsterers and paperhangers. Many students of other trades work out practically in the shop those things which they have drawn in the school. This work is often added to the collection of school models. The school employs, as far as possible, practical men for the oversight of practical work.

The school hours must be arranged to suit the trade and when possible must be chosen by the majority in each trade to fit its convenience. This is necessary in order not to take the boy away from the workshop when he is most needed and can learn the most. The master teaches the boy not alone for the love of the trade and the desire to assist but to earn a living; therefore, when he wants the boy he must have him or he will not endure the trouble of having an apprentice. School is in session from 7 a. m. to 9 p. m. Errand boys have little to do in the morning so their school time is from 7 to 9 a. m., and they are free afternoons and evenings when most needed. Bakers and milk boys work in the morning and attend school in the afternoon. Barbers, druggists, confectioners, waiters, call boys, and butchers can only be excused on certain days of the week at certain times of the day. Masons, carpenters and painters have seasons of work and go to school only certain seasons of the year, but more hours per day. It is difficult for the school management to arrange such a plan of hours because they lack teachers who make this their chief business.

The school allows the apprentice to go where he is able to get the best education. Commercial apprentices go to the business school. Many from the machine factories take the second part of the engineering school ten hours per week. Most apprentices belong in a one-trade division of the elementary grade in the continuation school. Only when they have completed this should they pass on into the mechanical or industrial art schools.

When a boy shows special talent in mechanics or art he should be freed as early as possible from the continuation school so that he may be able to go to the industrial art school where he can get better work. In all Germany it is agreed that the continuation school is the only genuine beginning trade school for all apprentices and it should prepare them to pass on into the higher schools.

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New York State Museum

John M. Clarke, Director

Museum Bulletin 148

GEOLOGY OF THE POUGHKEEPSIE QUADRANGLE

BY

larence
C. E. GORDON

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Hon. Andrew S. Draper LL. D.
Commissioner of Education

DEAR SIR: I beg to transmit to you herewith a manuscript entitled *The Geology of the Poughkeepsie Quadrangle,* accompanied by a geological map which has been prepared under my direction by Professor Clarence E. Gordon. The work has been executed with circumspection and accuracy and I recommend the publication of the matter transmitted, in the form of a bulletin of this Division.

Respectfully
JOHN M. CLARKE
Director

STATE OF NEW YORK
EDUCATION DEPARTMENT
COMMISSIONER'S ROOM

Approved for publication this 7th day of November 1910

A. S. Draper

Commissioner of Education

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New York State Museum

JOHN M. CLARKE, Director

Museum Bulletin 148

GEOLOGY OF THE POUGHKEEPSIE QUADRANGLE

BY

CLARENCE E. GORDON

INTRODUCTION

The preparation of this paper was begun at the suggestion of Professor J. F. Kemp. The field work was carried on at intervals during the summers of 1906-7-8-9. During the intervening winters the extensive literature dealing with the geology of eastern New York State, western New England and the areas of similar rocks at the south was read with care.

A preliminary map of the quadrangle was prepared by a summer school party of Columbia University at work for a week under the direction of Professor Kemp, Professor A. W. Grabau and Dr C. P. Berkey. This was of great assistance in the field.

The writer owes much to Professor Kemp for kindly criticism. Dr Charles P. Berkey has offered important suggestions. Particular thanks are due Professor John M. Clarke for a generous interest which has made some of the field work easier of execution.

LOCATION AND OTHER GENERAL FEATURES OF THE QUADRANGLE

The Poughkeepsie quadrangle lies in the Hudson river valley about midway between New York city and Albany. It falls between parallels 41° 30′ and 41° 45′ north latitude and meridians 73° 45′ and 74° 00′ east longitude, and is therefore 17.5 miles long by about 13.2 miles wide. It embraces an area of about 230 square miles. The Hudson river crosses the quadrangle from north to south near the western boundary. The river is slightly deflected to the west at New Hamburg and forms the quadrangle boundary at the southwest corner.

The larger portion of the area lies east of the Hudson in the southwestern part of Dutchess county. At the very southeast corner is a triangular bit of the township of Kent in Putnam county. West of the river is a strip of Ulster county and a block from the northeastern portion of Orange county.

Poughkeepsie, the county seat, is a city of about 25,000 inhabitants. Wappinger Falls on Wappinger creek, Matteawan on Fishkill creek and Fishkill Landing on the Hudson, opposite Newburgh, are important villages. Wappinger Falls and Matteawan are manufacturing towns and each owes its size and importance to the stream on which it is located. East of the Hudson the region is chiefly a farming country and is well adapted to tillage, grazing and fruit growing. West of the river the topography, soil and drainage are peculiarly adapted to the growing of fruit, for which the proximity of the river affords excellent climatic conditions.

Dutchess county was settled very early in the history of the State. The country is attractive. It is easy to imagine that immigrants voyaging up the Hudson through the inhospitable region of the Highlands would have been attracted by the stretches of open country which lay north of the rugged mountains.

The quadrangle is easy of access. Boats plying between New York and Albany stop at Newburgh and Poughkeepsie. The New York Central and West Shore lines, connecting with Albany and the West, follow the banks of the Hudson. The former joins with the Newburgh, Dutchess and Connecticut division of the Central New England at Dutchess Junction and Fishkill Landing, and at Poughkeepsie with the main line division of that road. At Poughkeepsie it also crosses the Highland division of the New York,

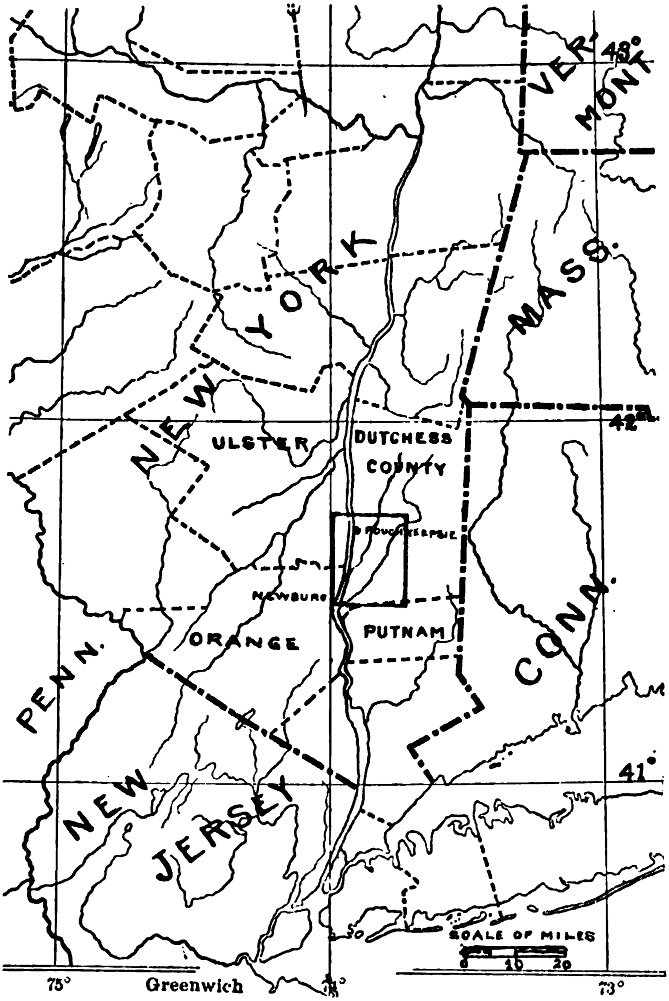

Fig. 1 Sketch map showing location of Poughkeepsie quadrangle

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New Haven and Hartford. Ferries cross between Fishkill Landing and Newburgh and between Poughkeepsie and Highland on the West Shore Railroad.

TOPOGRAPHY

East of the Hudson the topography is chiefly that of a rolling upland of moderate elevation, which is due in part to the nature and structure of the underlying rock formations as affected by erosion, and in part to the mantle of glacial deposits.

Along the southern margin of the quadrangle are several rugged spurs of the Highlands. These are bold, often precipitous, and usually wooded. They are known as the Fishkill mountains, receiving their name from old Fishkill township, of which they are a part. These mountains are made up chiefly of Precambric gneisses and are flanked by and faulted with the Paleozoics of the valley.

The westernmost Highland spur is the northern extension of Breakneck mountain ridge and the part within this quadrangle is known as Bald hill (see plate 1). It has a maximum elevation of 1540 feet. The Mount Honness spur next east has an elevation of 840 feet at its northern extremity, Mount Honness proper, but reaches a height of 1300 feet near the quadrangle boundary (see plate 2). A short spur east of Honness, with an elevation of 885 feet, separates it from Shenandoah mountain, which has a maximum height of 1115 feet. East of Shenandoah mountain the Highland mass attains an elevation of 1232 feet at " Looking Rock," which is at the summit of the steep northwestern slope. This spot is widely known because of its fine view.

North of the Fishkill mountains the rocks within the quadrangle are principally shales, slates, grits, phyllites and limestones. The more metamorphic character of these strata as they are followed eastward from the Hudson finds expression in the higher elevation of the slate and graywacke in the northeastern part of the area. Here the hills in places reach a height between 700 and 800 feet. West of the Hudson the average elevation in the slates and grits is greater than on the east of the river, often attaining 400 to 600 feet. " Illinois mountain," the northern extremity of Marlborough mountain, is 1105 feet high.

In contrast to the heights is the gorge of the Hudson, which borings have shown reaches a depth near Storm King of over 700 feet.

DRAINAGE

The Hudson river is the dominating factor in the drainage of this area. The principal tributaries of the master river within this quadrangle come in from the east. The most important are Wappinger and Fishkill creeks; of lesser importance are Casper and Fallkill creeks.

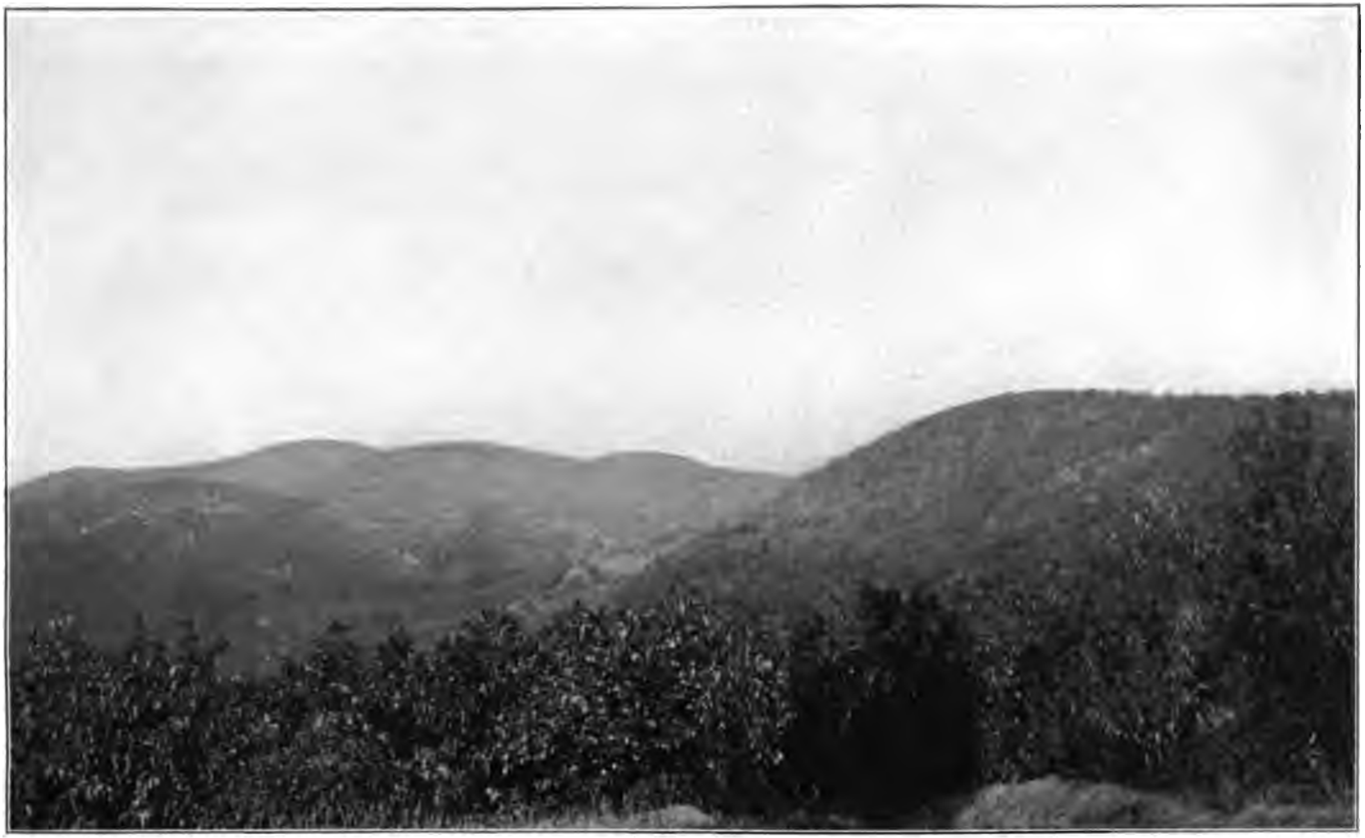
Wappinger creek has its source near Pine Plains, some 16 or 17 miles northeast of Pleasant Valley, on the southwest of a narrow divide that separates its headwaters from the valley of Shekomeko creek. It has a general southwest course along a narrow limestone belt, and finally enters the Hudson at New Hamburg. At present it bears away somewhat from the limestone along its lower reaches and flows across the slates, over which it cascades gently in several places. At Wappinger Falls it makes a descent of about 60 feet over the slates, and from this village to the Hudson, a distance of about two miles, it occupies a drowned valley. It receives a few small tributaries within the quadrangle, the largest of which drains the slates southeast of Wappinger Falls and empties into the main stream below the village.

Wappinger creek furnishes power at Pleasant Valley, near Titusville, and at Wappinger Falls, and formerly was utilized at Rochdale.

Fishkill creek is a somewhat larger stream and has a greater watershed. It also drains a large part of the area just to the east, where the main stream has its source on the western slope of Chestnut ridge, a high mass of schist separating the Clove and Dover-Pawling valleys. East of the quadrangle it receives an important tributary with its source in Whaley pond. Sylvan lake sends a small tributary into this stream near the eastern edge of the quadrangle.

Several good-sized brooks join the main stream from the north. Of these Whortlekill creek is a small brook which enters the quadrangle just east of Arthursburg, about a mile from its source. It joins the Fishkill about a mile south of Hopewell Junction. Jackson and Sprout creeks are larger. The former drains the western slope of the ridge between Lagrangeville and the Clove valley, while the headwaters of Sprout creek extend to the narrow ridge northeast of Verbank, whose eastern slopes drain into the Dover-Pawling valley. Sprout and Jackson creeks join north of Fishkill Plains and the stream formed by their union flows into Fishkill creek, two miles north of Brinckerhoff.

Plate I



A view of Bald hill, shown in the left half of the picture, as seen from Mount Beacon

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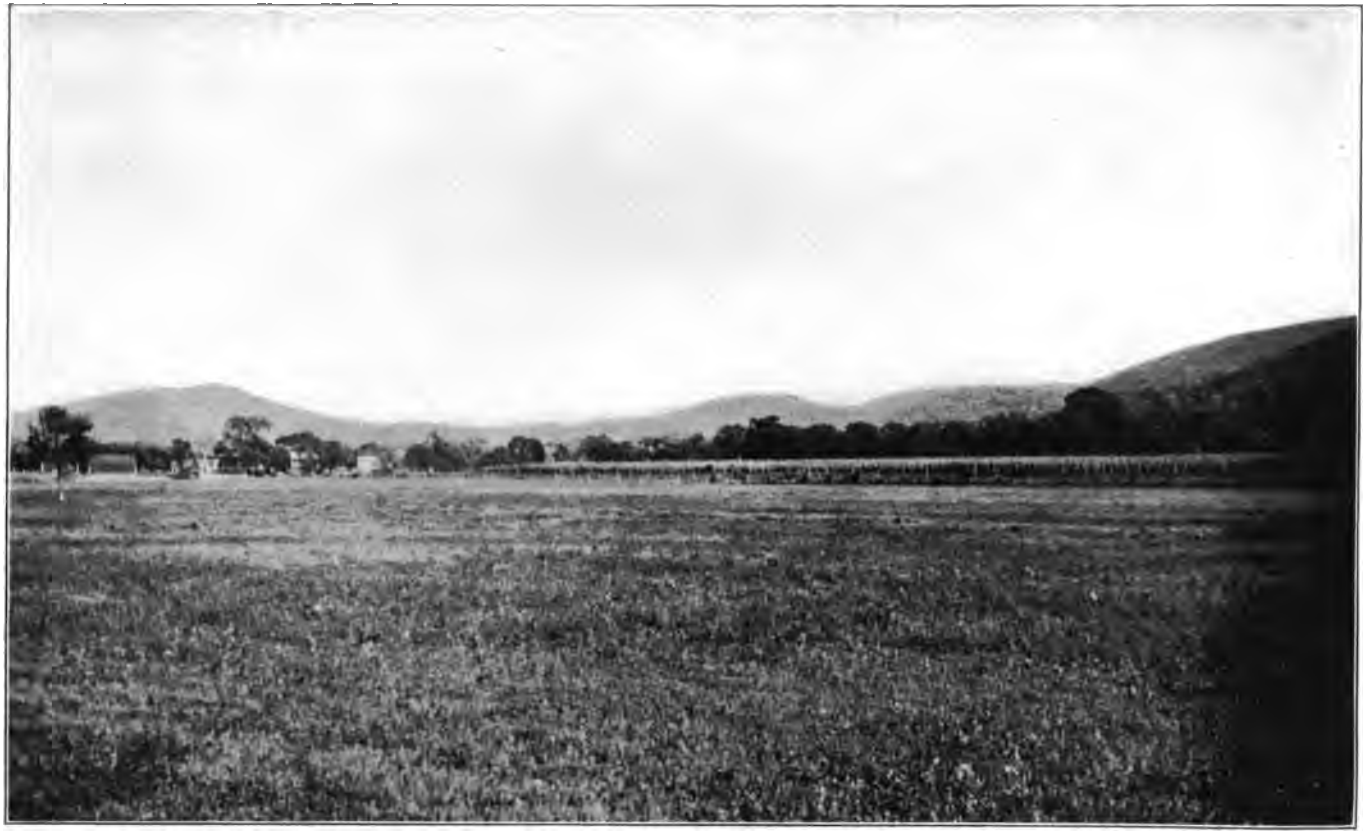
Plate 2



View of the Mount Honness spur of the Fishkill mountains, as seen from near the village of Glenham. The eminence on the left of the picture is Mount Honness proper

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Several brooks which drain the northern slopes of the Fishkill mountains and the valleys between them join Fishkill creek from the south. Of these, the largest are those leaving the Highlands through Shenandoah hollow and the valley of East Fishkill Hook, and "Clove creek" south of Fishkill Village. Fishkill creek furnishes power at Hopewell, Brinckerhoff and Matteawan.

Casper creek rises near the northern boundary and flows southwest in a rather wide valley to the Hudson which it joins two and one-half miles north of New Hamburg.

Fallkill creek drains a large area to the north. It flows in a general southwest course to Poughkeepsie where it turns on itself, and, making a large loop, flows north for one-half of a mile and then west to join the Hudson.

Several brooks, but none of any size, drain the slopes on the west of the Hudson.

There are no natural lakes or ponds of conspicuous size within the quadrangle. Those of any consequence apparently date from the time of the retreat of the ice sheet from this region.

GENERAL GEOLOGY

The Fishkill mountains belong to the Highlands province of Precambric rocks. These have their greatest development in Putnam county just to the south. The spurs that have been mentioned are the northern terminations of ridges of gneisses which have a general northeast-southwest trend. Above Peekskill these gneisses are continued across the Hudson into New Jersey. Eastward they extend into Connecticut.

The summits of the Fishkill mountains, with those of neighboring ones at the south, present a fairly even sky line which may be followed northeastward along the crests of the ridges of the younger rocks. This general uniformity of level is believed by many to mark a former peneplain in this region toward the close of Cretacic time (see plate 3).

North of the Fishkill mountains are the younger rocks of the area. In general, these do not now tend to climb far up the flanks of the older masses. In most cases the two are faulted against each other and the rocks of the mountains reach close to their bases. In a few places the younger strata extend up a moderate distance on the older rocks and are disturbed relatively little.

These younger strata rest unconformably upon the Precambric. They are the southwestward representatives of the rocks of western Massachusetts and Vermont and are now known to include strata which range in time from the base of the Paleozoic to the upper part of the Ordovicic period. Northeastward these rocks extend into Massachusetts and Vermont and southwestward into New Jersey, Pennsylvania and beyond.

Within the quadrangle they are of considerably lower average elevation than the gneisses of the mountains. This reduced elevation is believed to represent the erosion that has taken place in these rocks below the Cretacic level after the peneplain had been elevated at the close of Cretacic time.

So far as now known, these younger strata have no later rocks older than the Quaternary overlying them within the limits of the quadrangle.

PREVIOUS GEOLOGIC WORK

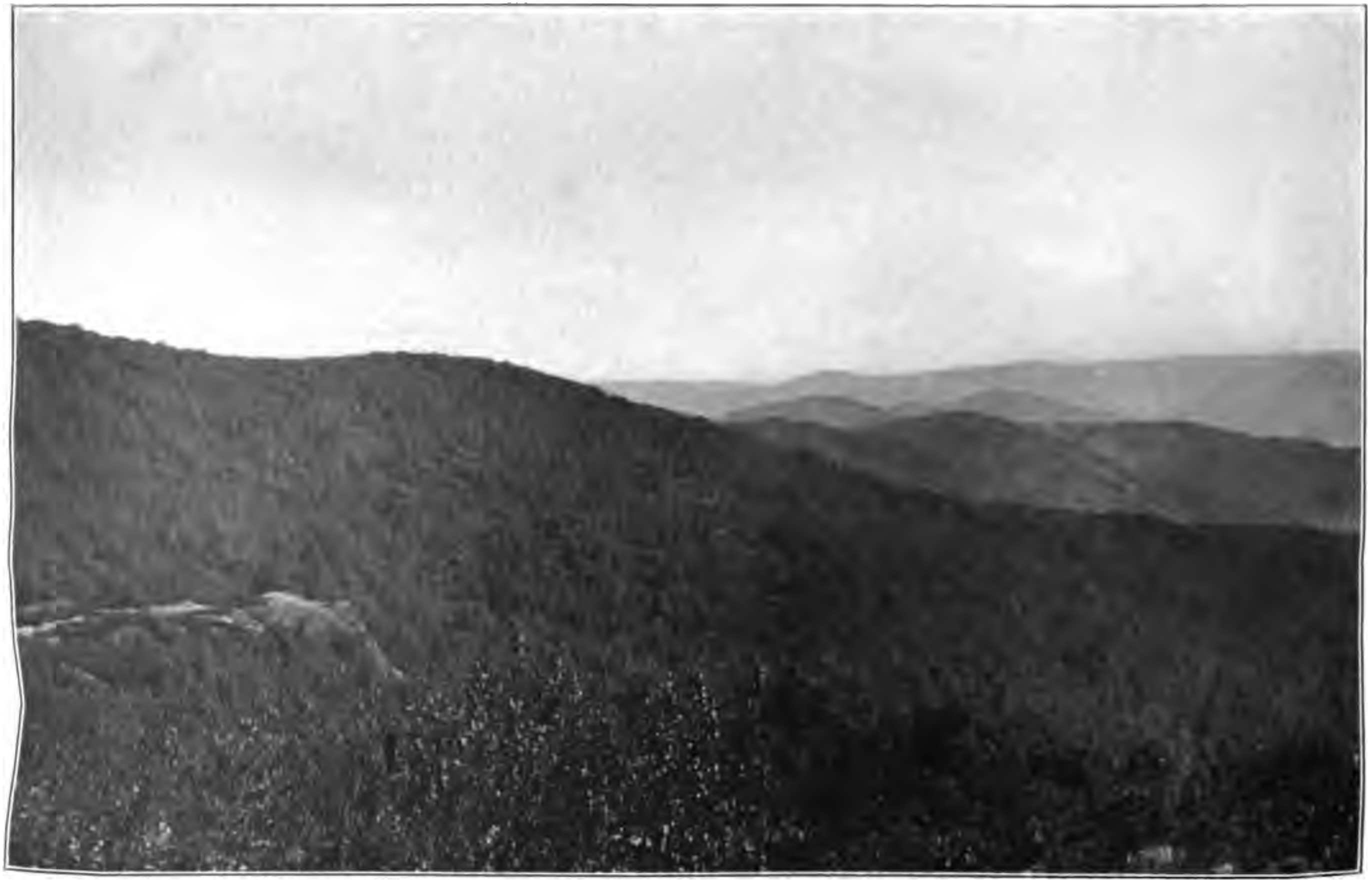
Because of the extensive geographic development of these rocks and their difficult geology there has appeared, during the last fifty years or more, a large body of literature dealing with them throughout their length and breadth. The work has been carried on under the auspices of State and federal surveys and by private enterprise. Work within this quadrangle was undertaken early in the history of serious geological investigation in this country.

In 1843 W. W. Mather submitted his quarto report on the Geology of the First District of the State of New York. This dealt with southeastern New York and was the first important contribution bearing on the geology of this area. With the exception, perhaps, of an excursion by Sir William Logan and James Hall in 1864, which resulted in the assignment of the younger rocks of this and neighboring areas to Logan's Quebec Group, and which introduced much confusion at the time, no other important contribution was made until 1878.

In that year T. Nelson Dale discovered fossils in the slates at Poughkeepsie. The fossils were assigned by Hall to the " Hudson River Group." The find attracted the attention of Professor J. D. Dana to the strata of southern Dutchess county. This eminent geologist, what the time was working at the difficult stratigraphy of western Massachusetts and the neighboring portion of New York State, now traced the limestones from the north to the Hudson river, discovered fossils in them at Pleasant Valley, and discussed their general geologic significance.

Apparently through the influence and encouragement of Dana, Professor W. B. Dwight began his fruitful investigations in the Wappinger limestones of Dutchess county. Professor Dwight's papers were published at intervals from 1879 to 1900. His investi-

Plate 3



A view from Mount Beacon southwestward along Breakneck mountain, across the Hudson river, showing the dissected Cretacic peneplain. The rounded dome of Storm King is shown on the right of the picture in the distance.

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gations greatly extended our knowledge regarding the age of the Wappinger limestones, particularly those of the Wappinger creek belt.

In 1886 J. C. Smock, as a part of a preliminary report on the Precambric rocks of the Highlands east of the Hudson, discussed the gneisses of the Fishkill mountains. But notwithstanding these contributions, the areal geology has not been mapped in detail up to the present time.

STRATIGRAPHICAL TABLE

PERIODS	SEDIMENTARY		ERUPTIVES
	Formations	Terranes	
Quaternary	Alluvium	Recent	
	Terraces Kames Drumlins (Unconformity)	Glacial	
Ordovicic	" Hudson River " slates, grits and phyllites	? Utica? Trenton	Hortontown hornblende rock
	Wappinger limestones and dolomites, in part	Trenton (Disconformity) Beekmantown	
Cambric	Wappinger limestones and dolomites, in part	(Disconformity?) Potsdam ? Georgian	
	Poughquag quartzite (Unconformity)	Georgian	
Precambric	Gneisses of the Fishkill mountains and inliers of these rocks	" Grenville "	Shenandoah granite Bald Hill granite gneiss

THE PRECAMBRIC GNEISSES

DISTRIBUTION

Within the Fishkill mountains the boundary of these rocks, as shown by the map, follows closely the lower contour lines of the spurs.

The Glenham belt is an inlier of these rocks. It has the same trend as the ridges of the gneisses in the Highlands and extends as a narrow strip from a point just north of the carpet mill at Glenham northeastward to " Vly mountain."[1]

---

[1] The hill marked Fly mountain on the map is just southeast of what, in this vicinity, is called Vly mountain, corrupted to Fly mountain. The swamp just south of the eminence doubtless suggested the name (Vly-swamp).

South of the Glenham belt, in the town of Matteawan, are two smaller inliers of the gneisses connecting the Glenham belt with the Highlands.

Between the rocks of the Highlands and those composing the masses of inliers there are some differences which help to throw light on the history of both. There are also marked resemblances which apparently serve to clinch their relationship.

PROBLEM OF THE GNEISSES

The study of the gneisses speedily develops very puzzling problems, which in all cases may not admit of satisfactory solution. In some way these rocks must express the several successive changes which they have experienced. A complex history is suggested, but all its events are not easy to trace.

PROMINENT STRUCTURAL FEATURES

The most impressive feature of the gneisses is the northeast-southwest alignment of the ridges which constitute their outcrop. Between the ridges are parallel longitudinal valleys. From the published descriptions, these features, with some exceptions, seem to hold for the entire Highlands and to extend southward into Westchester county.

The gneisses are uniformly banded or foliated throughout their entire breadth from west to east, and the strike of the foliations in general follows the trend of the ridges. In a few places only does the foliation approximate schistosity in any degree.

Over most of the area there is an easily distinguishable arrangement in parallel stratalike masses which also follow the topographic features. These do not show an orderly repetition, though masses of very similar mineralogy are irregularly repeated. Occasionally more massive types occur, but these, too, seem to follow the structural features just mentioned. The prevailing dip of the foliation planes to the southeast imparts a strongly isoclinal character.

The ridges clearly date from Postcambric time. It seems reasonable to infer that the other structural features just outlined have a common origin and belong to an earlier epoch.

There is much evidence of extensive faulting which is developed chiefly, or at least most prominently, along the strike. Such faulting might easily account for the lack of orderly repetition of characteristic rock types. Most of this faulting belongs to the disturbance that produced the ridges. The gneisses clearly show the effects of repeated orogenic disturbances.

In some places it is clear, from the position and structure of the overlying younger rocks, that most of the features of the gneisses date from Precambric time. Where the relationship of the basal quartzite to the underlying gneiss is most plainly seen, as in the West Fishkill Hook,[1] the latter stands at a high angle with a uniformly northeast-southwest strike, while the quartzite dips at a low angle with varying strike. In other places the discordance between the dips and strikes is plainly discernible. The quartzite has been folded relatively little in many places, and never within this quadrangle to the extent shown by the gneisses. Faulting, instead of extreme folding, occurred in connection with Postcambric movements within the gneisses.

The early crystalline condition of the gneisses would have favored faulting and shearing and would have prevented much later folding within them. It is certain that the isoclinal character is of Precambric age.

It seems possible, therefore, in a large way, to apportion the structural features of these gneisses as seen in the field among orogenic movements of Precambric and later time. It is quite uncertain how many different disturbances may have occurred in Precambric time and whether all the later structural features are of similar age.

The lines of foliation, as seen in outcrops, are usually rectilinear. When wavy, they are only slightly so. This latter feature seemed most noticeable on Shenandoah mountain. Crinkling is rare. Two or three instances of it were noted in the Glenham belt. Jointing is common and frequently gives the appearance of thick exfoliation.

Faults are divisible into two kinds, reversed and normal. It seems most likely that the normal faults followed the compression that produced the thrusts and are therefore of the nature of adjustments. All the faults that have been noted appear to belong to the great mountain building process of Ordovicic time which elevated the Paleozoics of the Green mountain belt. This is indicated by the relations which exist between the younger and older rocks and by the fact that the fault lines of the mountains are projected northward into the younger strata, where they show features that leave their age unmistakable.

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[1] The recesses east and west of the short spur that separates Mount Honness from Shenandoah mountain are respectively known as East and West Fishkill Hook.

Doubtless in some cases what now appear to be reversed faults of moderate displacement within the gneisses, or along contacts, are truncated thrusts of large size. This inference is borne out by the presence of large thrusts in the Paleozoics at the north.

It would appear that not only did distinct normal fault breaks occur as the result of adjustments following the elevation of the Green mountains, but that normal slips occurred along the planes of the earlier thrusts.

This feature is best shown in the relations now existing between Bald hill and the Mount Honness spur, and in similar ones between Shenandoah mountain and the mass of gneiss at the east of it. In these two instances the Paleozoics have clearly been dropped back between the gneiss spurs with a large throw on the west, marked in one case by the scarp on the east of Bald hill, and in the other by that on the east of Shenandoah mountain.

The two spurs in each case tended to act as a single block. The normal fault intersects the thrust at an acute angle forming a triangular valley narrowing southward. Some backward movement along the thrust plane must have accompanied the slump. Diminishing tension faulting eastward is marked by small scarps on the west of the Honness spur but is not noticeable on the eastern gneiss mass.

The Hook spur shows these features imperfectly developed.

PETROGRAPHY

General. The gneisses show much similarity in their mineralogy. Distinctive characters are furnished by the structure, the preponderance of some minerals, or the degree of alteration in the rock. A few composite types may thus be defined. It will be convenient to describe these first, while the variations in many instances may best be indicated in discussing their outcrops. The thin sections may be reviewed as a whole later. Possible ancient surface alterations must always be carried in mind.

Bald hill granite gneiss. This rock is prominently developed within and south of the quadrangle. There is great uniformity in its general color, mineralogy and texture. It shows a few variations, but as a whole is remarkably homogeneous. In outcrops it is commonly drab colored and granitelike in appearance. The thin section of the usual variety shows quartz in large and small anhedrons. Orthoclase and plagioclase are abundant, with the former slightly in excess. There is some microcline and hornblende is plentiful. Irregular grains of magnetite are frequent. There are a few scattered zircons.

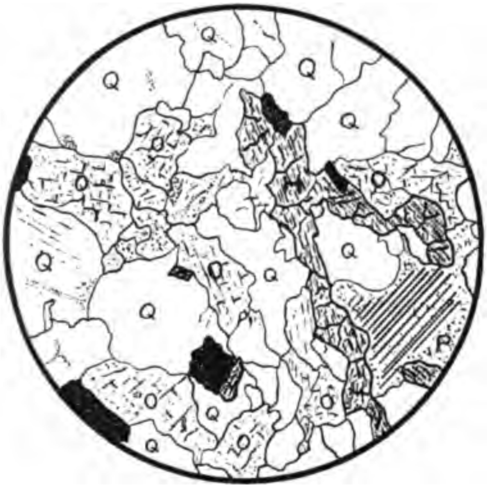

Fig. 2 Bald hill granite gneiss. Actual size 3 mm. *Q*, quartz; *O*, orthoclase; *P*, plagioclase; *H*, hornblende; black, magnetite

In some instances, even where the hand specimen appears rather massive, the thin section shows a stringer-like arrangement of the hornblende (see figure 2). The magnetite is often hydrated, giving surface exposures a rusty color.

The principal variation is a rock of coarser texture, with the mineralogy of a diorite. It shows hornblende, abundant plagioclase and a very little quartz (see figure 3).

In one case where the rock was extremely fresh the magnetite formed a perfect pseudomorph after the amphibole and was abundant in the section, while the hornblende was greatly bleached.

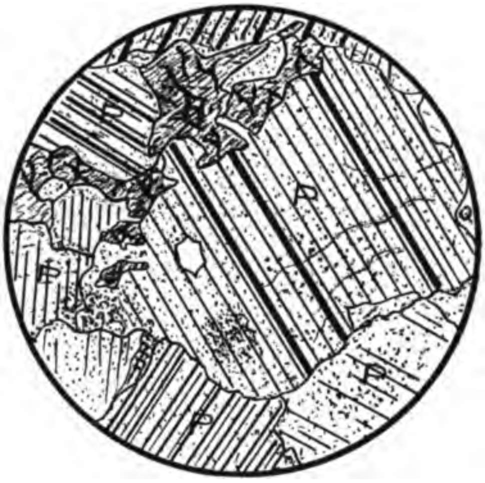

Fig. 3 Diorite variation of the Bald hill gneiss. Actual size 3 mm. *P*, plagioclase; *H*, hornblende; *Q*, quartz

There is utter lack of evidence to show that the rock has undergone a complete change from an earlier condition. It would seem that, so far as the rock has just been discussed as to mineralogy and texture, we are dealing with primary features. On the whole, the sections indicate a rock of plutonic habit which took on a gneissic character and underwent certain other changes at the time of its formation. The gneissic character is best regarded as primary, justifying the use of the term gneissoid granite to qualify the name granite gneiss.

The restlessness of the magma at the time the minerals were forming seems to find expression in the stringerlike arrangement of the hornblendes and in parallelly arranged pellets of quartz occurring in the feldspars, which do not appear to be secondary and of later introduction. These features, with the rounded character and smaller size of some of the grains and the absence of micropegmatitic intergrowth, point to conditions hampering crystal formation.

The thin sections also show certain dynamic effects of later date, in common with all the gneisses of these mountains, in the form of strain phenomena of different kinds. There are one or two instances of comparative freedom from such in which the quartz always gives sharp, decisive extinction and in which prominent cracks and bent lamellae are absent.

Hornblende gneisses. The outcrops of these rocks are much alike and the thin sections which have been examined agree very closely. Exposures are dark in color. The essential minerals are chiefly plagioclase and hornblende, with some quartz and a little orthoclase. Magnetite is rather common as irregularly-shaped particles, or as dustings. Zircons are occasional. Some sections show biotite in addition to hornblende, but the former is decidedly subordinate and usually has every appearance of being secondary. It apparently belongs to that period of metamorphism which more usually found expression in strain phenomena of different kinds but which sometimes resulted in new minerals among the "primary" ones, especially in those cases where the rock had previously been exposed to unusual alteration. The feldspars also frequently show evidence of former decay. The indurated and general compact

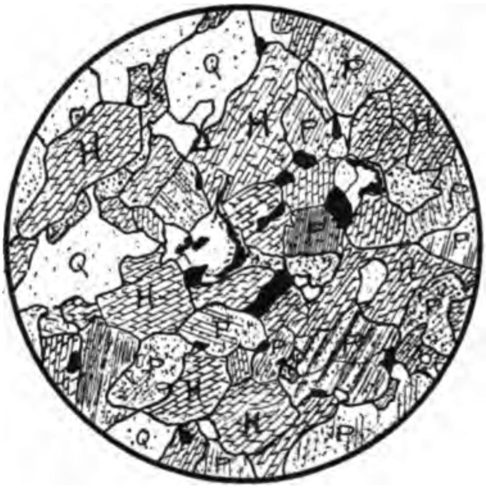

Fig. 4 Sketch of a hornblende gneiss. Actual size 3 mm. *Q*, quartz; *P*, plagioclase; *H*, hornblende; black, magnetite

condition indicates that the alteration is an ancient character. Figure 4 gives a sketch of a thin section of typical hornblende gneiss.

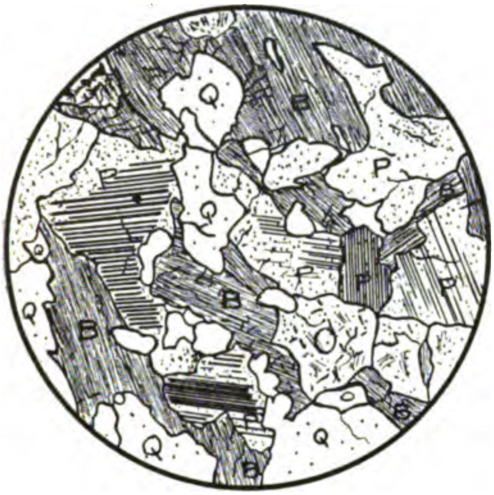

Fig. 5 Sketch of a micaceous gneiss. Actual size 3 mm. *Q*, quartz; *O*, orthoclase; *P*, plagioclase; *B*, biotite

Micaceous gneisses. These may be passed over briefly. Except that biotite plays the rôle of hornblende, they are very similar in their mineralogy. In some cases magnetite is associated with a mineral whose identity is lost or obscured. The thin sections often suggest that the prominent biotite is secondary and in these cases the outlines of another mineral, possibly hornblende, may be faintly traced. In these instances it is possible that the biotitic gneiss was first a hornblende rock and that it was subjected to more than usual alteration before recrystallization.

Microcline is rather abundant. Biotite occurs abundantly as a " primary " mineral independent of hornblende. Sometimes these gneisses show much quartz and are finegrained, strongly suggesting altered sediments.

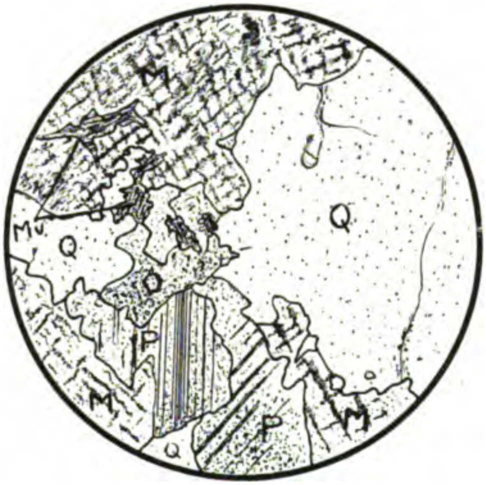

Fig. 6 Shenandoah mountain granite. Actual size 3 mm. *Q*, quartz; *O*, orthoclase; *P*, plagioclase; *M*, microcline; *Mu*, muscovite

Shenandoah mountain granite. A coarse, white granite made up almost entirely of quartz and feldspar was noted on Shenandoah mountain at the summit of the steep northwestern slope, along the road from the East Hook to Hortontown. It is very massive in appearance in the ledge and hand specimen. The thin section shows quartz, orthoclase, microcline and plagioclase. A few small and scattered flakes of muscovite, which is probably a primary mineral, are present. Microcline is abundant. There is a tendency to microperthitic intergrowth of plagioclase and orthoclase. It has the earmarks of a plutonic rock and bears little evidence of gneissoid structure, so that if it is of Precambric age it must be thought of as having escaped any pronounced foliation. This seems remarkable, considering the prominence of foliation in the gneissic series. The effects of dynamic metamorphism are chiefly in the form of strain shadows in the quartzes.

Glenham gneiss. The prevailing and characteristic surface rock of the Glenham belt is a granitic gneiss. It appears to be an altered derivative of other gneisses which are entirely similar to those of the Highlands, and which are exposed in places within the belt. The surface gneiss is foliated in certain portions, while in others it is massive. There are minor variations in texture and in mineralogy which depend upon both an ancient and a more recent alteration. These varieties grade into one another. The gneiss is usually red from disseminated iron stains and over much of the belt is deeply chloritized.

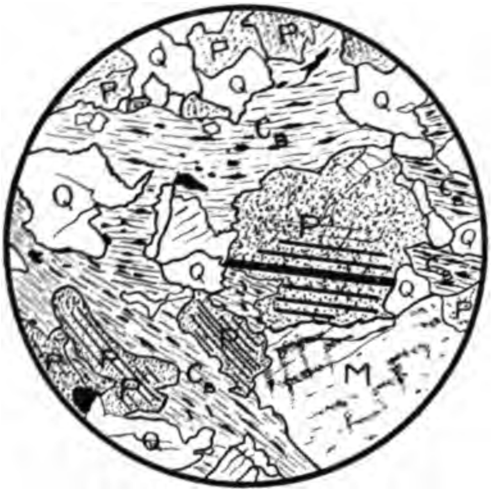

Fig. 7 Glenham gneiss. Actual size 3 mm. *Q*, quartz; *M*, microcline; *P*, plagioclase; *Cb*, chlorite after biotite, carrying magnetite

The thin section shows abundant quartz with orthoclase, microcline, plagioclase, and biotite altered to chlorite. Magnetite is abundant and zircons are occasional.

Occasionally the rock consists of feldspar and quartz with very little or no mica.

OUTCROP OF THE FISHKILL MOUNTAIN GNEISSES

Matteawan. Gneisses which can be readily traced into those of the Fishkill mountains outcrop near their base in the eastern part

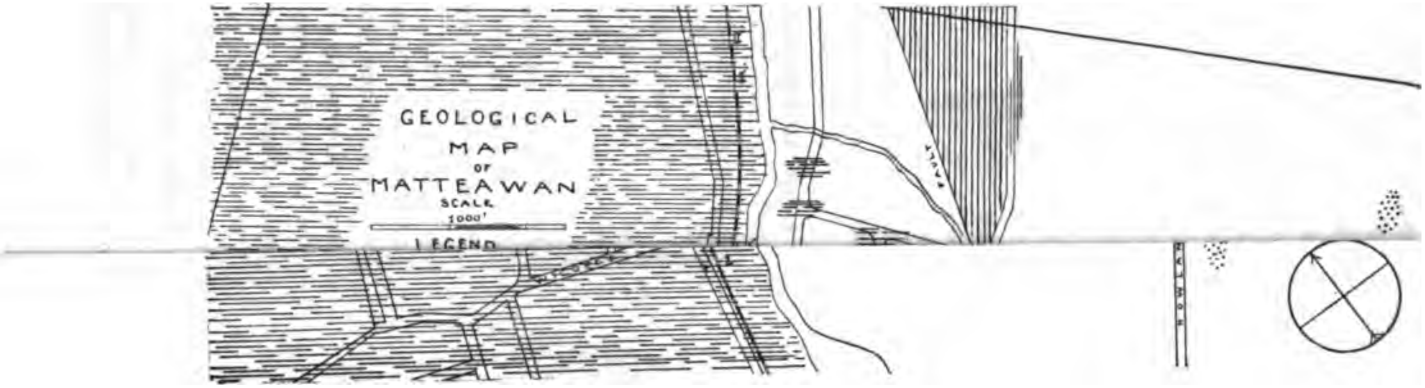
GEOLOGICAL
MAP
OF
MATTEAWAN
SCALE
1000'
LEGEND
FAULT
HOWLAND

Figure 8

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ASTOR, LENOX AND
TILDEN FOUNDATIONS

of the town of Matteawan. The discussion of these may be followed by reference to the map of Matteawan (figure 8).

The most western outcrop which has been noted is at the corner of Vail avenue and Washington street. The gneiss at this spot is very similar to that which composes the two inliers shown on the map at the northwest. Another outcrop occurs at the junction of Prospect and Mountain streets. A line drawn between these two outcrops marks the western boundary of the gneisses of the mountains, so far as they can be followed by actual outcrops. East of Washington street along Prospect, Union, Robinson and Alice thoroughfares and along Green, Park, Duncan and Goodrich side streets, outcrops are numerous. North of Mountain street the gneisses pass beneath the drift. A quarter of a mile to the northeast they are exposed again in the gorge of Mount Beacon brook. The reddish and greenish colors, characteristic of the Glenham belt and the inliers farther west, and frequent epidotic gneiss, were noted among the surface exposures of the gneisses just described. Otherwise these exposures are similar to the rocks in the Mount Beacon brook section.

Mount Beacon brook section. Above and for a short distance below the bridge on Mountain street, near the foot of the mountain road, the brook has cut an interesting section in the gneisses. Just above the bridge the foliation and " bedding " planes strike n. 54° e. and dip about 75° s. e. Below the bridge the strike varies between this angle and 69° e. of north. The rocks in this section show an isoclinal arrangement in " beds " with high dip to the southeast.

Below the bridge, the lowest portion of the section involves some forty feet of dark hornblendic gneiss. This rock is banded, though in places for the width of several inches it is massive. When waterworn, such surfaces present a spangled appearance. This " stratum " is abruptly succeeded by a lighter colored one of much less uniformity of appearance. It is made up of imperfect alternations of granitic, quartzitic and composite " beds," which vary in thickness from the width of an inch or less to two feet. Some " beds " show light and darker bands. Others are uniformly light colored, often with little or no trace of a ferromagnesian constituent. This " stratum " continues up stream for a hundred feet or more and passes beneath the bridge. It is succeeded by the Bald hill gneiss with varieties that strongly resemble the rocks of the Glenham belt and the Matteawan inliers in texture and mineralogy.

In the upper portion of the gorge above the bridge the north wall for some distance is a rusty, pinkish rock of fine grain and rather massive appearance. It resembles certain phases of the basal quartzite which have been noted outside the quadrangle, particularly the outcrops in the brook crossed by the mountain road a mile south of Dutchess Junction. This rock is jointed, and rests upon the granitic derivative of the Bald hill gneiss.

Bald hill. The rock composing this spur of the Highlands was carefully examined along its base while tracing the quartzite, and also in two sections across its summit from west to east. One of these sections was made across the northern portion of the spur along an old wood road leading from the lane southeast of the Maddock farm near Glenham station. The other was taken partly along the road ascending Mount Beacon, then bearing to the left past the Graham place through " Hell Hollow " to the Cold Spring road. The rocks in the quarries near Mount Beacon reservoir, and in the excavations made for the new house at the summit of Beacon during the summer of 1908, as well as the section along the road descending from the reservoir to Matteawan, were studied. Comparisons were made with the outcrops along the base of the ridge to the quarry at Storm King station and in the railroad cuts from Storm King to Cold Spring. An examination of other parts of the ridge of which Bald hill is the northern extremity, was necessary in order to form a clear idea of the character of the gneiss.

Along the northwestern slope of the spur the gneiss is mainly a medium-grained, laminated hornblende rock with some micaceous variations. Along the basal portion of this slope the gneiss is usually rusty from included iron stains. Higher up it is commonly a drab or gray rock. The laminated character is more noticeable and the laminations are finer along the basal portion of the northwestern slope. Throughout most of the mountain the gneiss is rather coarsely or indistinctly foliated and in places is quite massive and granitic in appearance.

The characteristic rock of Bald hill, as just described, is identical in texture and mineralogy with the rock in the quarry at Storm King station and with the prevailing type in the railroad cuts between Storm King and Cold Spring. It is the chief variety in the quarries at Mount Beacon reservoir.

At the excavations for the new mountain house on Beacon, the drab-colored granitic gneiss passed into a variety composed of white feldspar and hornblende. In the hollow between Beacon and Bald hills, along the road descending from the reservoir, the granitic hornblende rock is often very dark in color, which corresponds with a greater freshness in the rock.

The presence of occasional micaceous variations has been noted. They are apparently confined to the more finely laminated portions of the gneiss and there is reason for thinking that the mica is secondary. The thin sections show abundant disseminated magnetite which has become hydrated in many places, giving surface exposures a rusty color.

The homogeneous character of the Bald hill granite gneiss is noteworthy. In areal extent, it covers about eleven square miles east of the Hudson. The general igneous character of the rock is very impressive. The varieties that have been described would appear to be explainable as normal variations from a common magma.

This rock is certainly of Precambric age. By its form and isolation it does not appear to have the character of a basal member. I have been unable to discover any other type which could reasonably be referred to this gneiss. If a basal formation, it should be of more frequent occurrence in these greatly eroded rocks. It therefore does not appear to be older than the other gneisses. All evidence of a possible unconformity would have been completely obliterated.

If contemporaneous with the other gneisses, on the assumption that they are sedimentary and that it is igneous and having the character of a sill, it should then occur also in other places to the east. It might be a laccolith, in which case it might have furnished the initial bulge at the time of folding. The more strongly banded character of the gneiss along the margin and the somewhat massive central portions might permit the interpretation of anticlinal structure.

The pronounced alignment which this granite has with the other gneisses favors the view that it was thrust up into the gneisses at the time of their folding. All possible exomorphic and endomorphic effects would have been neutralized by the agencies of regional metamorphism.

In addition to its other characters, the thickness of this formation is opposed to the idea that it is of sedimentary origin.

The Mount Honness spur. A short distance east of the Cold Spring road in the hollow between this spur and Bald hill the rock resembles the Bald hill gneiss. In some places it is granitelike, coarse-grained and only slightly foliated, looking like an altered derivative of the gneisses. The fault that borders Bald hill on the east may be within the Bald hill gneiss for a distance.

North along the road toward Fishkill Village the rock becomes more foliated. A thin section of this variety shows some biotite in addition to hornblende, but the former is decidedly subordinate and is apparently secondary.

Two mountain roads over this spur from the Cold Spring road to West Fishkill Hook give fair sections. There are also numerous outcrops in the fields to the north and south. Surface exposures are confusing both as to structure and petrographic characters. In some places the gneiss apparently dips to the northwest at low angles, but where the foliation planes may be detected, they dip to the southeast at high angles. The rock often has a granular and hybrid character that seems best interpreted as the condition resulting from the induration of a partially disintegrated rock which is primarily a very ancient character. The apparent northwest dip is accordingly best explained as a sort of exfoliation between the basal gneiss and the altered surface derivative.

On the whole, the section is across a series of " strata " showing tendency to definite alignment with each other and to variety of composition. In the main the rocks of this spur may be classified as micaceous and hornblendic gneisses forming rather thick " strata," which usually exhibit uniformity in mineralogy for some distance across the strike.

The road from Brinckerhoff to Johnsville crosses this spur north of Mount Honness proper. Fine exposures have been made in the dark colored hornblende gneisses along the road in the process of constructing the new State road, and in the quarries just south of Arvis Haight's, from which stone was removed. These sections show thick masses of the hornblende gneiss. Lighter colored gneisses have been noted interstratified with the hornblende varieties.

In connection with the question of the origin of the hybrid character of the gneiss along the northwestern slope of this spur it is interesting to note that the slope is gentle. Although it now lies in a faulted position against the limestone, the basal quartzite may have reposed on the gneiss along this slope subsequent to the elevation which brought the gneiss against the limestone.

More distinct " passage beds " overlying the inclined gneiss occur just beyond the point where the two mountain roads cross on the crest of the ridge. Between the eastern fork of the roads thus formed, west of the barn of Irving Knapp, thick masses, resembling both the gneisses and the quartzite in their mineralogy, dip to the north at a moderate angle. Farther along the road to the east of the house, ledges more closely resembling the quartzite were found. The woods and thick covering of drift, however, greatly obscure everything to and for a short distance beyond the west road into the mountains. South of the Carey farm, between the brook and the road, the quartzite was found grading downward into a hybrid rock.

The Hook district. South of the quartzite slope, back of the farm of Garrett Smith, the thick woods obscure the succession in the gneisses and good outcrops are scattered. The outcrops in the field southwest of Alonzo Smith's house (see plate 4) on the east road into the mountains and in the neighboring woods, are micaceous gneisses. Within the small space of the outcrop shown in the plate the gneiss passes from a rather coarse rock with quartz stringers through one with finer laminations into a purplish rock with still finer laminations.

A comparison of the thin sections of these varieties shows a similarity as to essential "primary" minerals with biotite as the ferromagnesian constituent. The feldspar is chiefly plagioclase. Quartz is abundant. The degree of alteration of the primary minerals varies much. It is severe both in the feldspars and the biotite, but shows itself chiefly in the latter. In the coarser gneiss the biotite is only slightly altered, while in the finely laminated purplish rock it is represented by masses of magnetite and a great abundance of finely granular material, probably sericite, with only occasional traces of the boundaries of the original mineral (see figure 9). The second variety mentioned shows a gradation between the

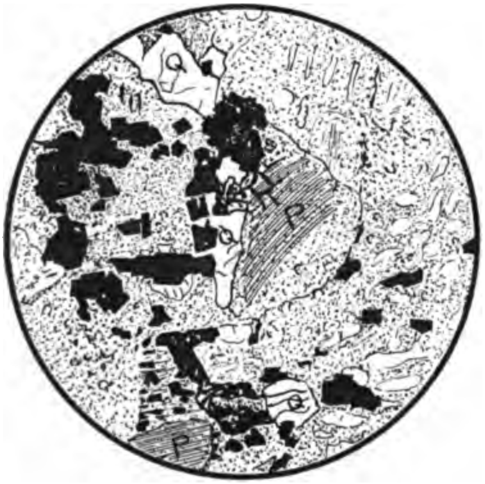

Fig. 9 Altered micaceous gneiss from the Hook district. Actual size 3 mm. *Q*, quartz; *P*, plagioclase; black, magnetite from biotite

otherwise. The purplish color of the darker rock is plainly due to the abundant magnetite.

Though apparently greatly decomposed, these rocks are firm and compact in the hand specimen. The magnetite is not altered into hematite or limonite. The conditions suggest that the alteration of these rocks dates back to an epoch preceding the deposition of the basal quartzite, which, as the proximity of this formation shows, formerly covered the gneisses, probably until glacial time.

East of the east road into the mountains the quartzite has been dropped by a fault. It extends farther to the south than on the west of the road, partly on this account and partly because of a syncline at this point. No peculiar variations were noted in crossing the Hook spur to East Fishkill Hook. The southward extension of the quartzite leaves comparatively few outcrops outside the thickly-wooded area of the spur.

Shenandoah mountain.[1] Above the drift-covered slope of the quartzite, along the northwestern slope of the mountain, dark, micaceous gneisses were noted in conspicuous ledges. Along the road from the East Hook to Hortontown, these were succeeded near the summit of the mountain by a light granite interbedded with the gneisses and estimated to be from forty to sixty feet thick. I have called this the Shenandoah mountain granite. With the exception of one or two quartzitic members, the usual succession of the gneisses is crossed in going from the granite "stratum" across the mountain to Hortontown. On the whole, the micaceous types seemed more abundant. Outcrops are numerous along the road and in the fields on each side.

The age of the granite can nct be affirmed. It appears to have the strike of the adjacent gneisses; but it did not prove possible to trace it more than a few hundred feet. The quartzite formation, or its possible equivalent, was not found resting on the granite, so that its age could not be definitely assigned by showing an unconformity. If thrust up into the gneisses at the time of their folding, it has escaped foliation. It probably belongs to the Precambric series. If so, the absence of foliation indicates that Postcambric movements did not contribute to the characteristic foliation of the gneisses.

The eastern gneiss mass. The rocks along the northwestern base of the eastern gneiss mass in some cases suggest a continuation of those of Shenandoah mountain.

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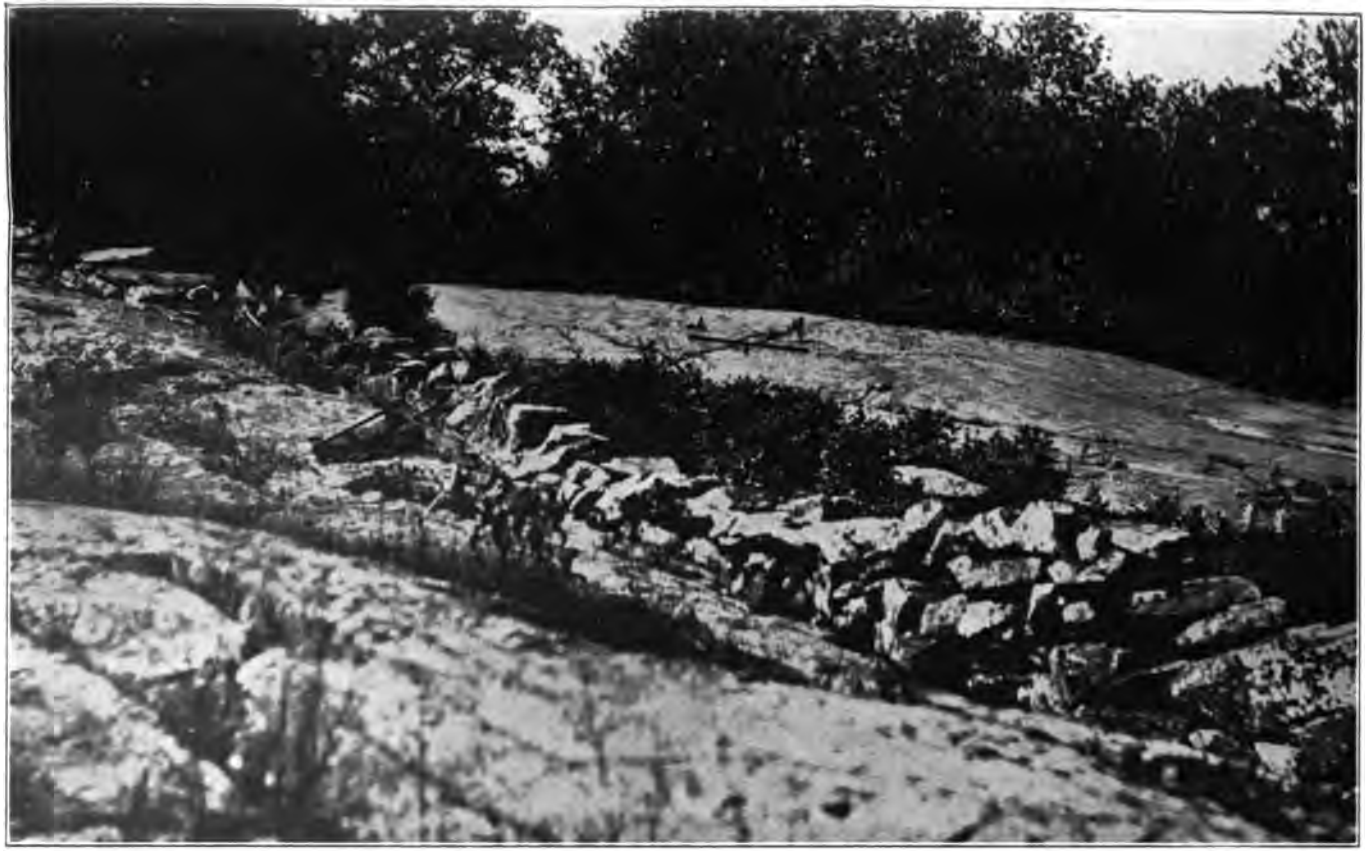
[1] The spur next east is locally known as Shenandoah mountain, from the hamlet of that name at its northern termination. The Shenandoah of the map is East Fishkill Hook.

Plate 4



Showing the unconformity between the Precambric gneiss and the Lower Cambric quartzite. The glaciated gneiss beyond the wall dips to the east by southeast at a high angle, while the quartzite in the foreground dips to the northeast at a low angle. Photograph taken on the farm of Alonzo Smith in the West Fishkill Hook district

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ASTOR, LENOX AND
TILDEN FOUNDATIONS.

At Fowler's kaolin mine, east of Shenandoah, a rock was found beneath the kaolin deposits that was almost identical with the Shenandoah mountain granite, though coarser in texture. The decomposed rock, from which the kaolin was derived, is usually coarse, showing quartz chunks the size of a walnut in a mass of altered feldspar. Probably the kaolin is the product of the disintegration of a pegmatitic granite. The clay beds are apparently not very extensive, although their exact extent is obscured by glacial deposits along the slope. If the kaolin is thought of as the decomposition product of an arkosic, conglomeratic quartzite, it is difficult to account for the granitoid texture of certain specimens examined and the perfect resemblance which they have to the Shenandoah mountain granite. The quartz chunks are not rounded as one would expect in a conglomerate. A careful search failed to reveal the quartzite in the neighborhood.

The structural features suggest that certain gneisses of this mass probably are faulted portions of the Shenandoah spur. Their resemblance might, of course, be explained as due to repetition.

At Hortontown, near the quadrangle boundary, there were noted certain gneisses which had an almost unmistakable sedimentary appearance. Though firmly crystalline, the quartzes frequently show a granular character on the fresh surface of the hand specimen, and the thin interlocking and dovetailing light and dark bands and fine texture indicate an impure sediment. There is nothing about such varieties that points to an altered igneous rock.

The gneisses of the eastern mass were examined in their outcrops along the base of the northwestern slope, along the mountain roads and to some extent along the wooded summit. It did not prove possible to assemble them into an orderly series. They present irregular repetitions of hornblendic and micaceous gneisses with some few minor variations. The micaceous gneisses were the more abundant.

No decidedly massive types were noted. The thin sections are not conclusive as to the early condition of these gneisses, although in many cases they hint at altered sediments or ancient derivatives.

THE GNEISS INLIERS

The Glenham belt. The southern extremity of this belt is a few yards northwest of the dam at Groveville. Above the dam it forms the west wall of the gorge of Fishkill creek as far as Glenham. Northeastward it may be followed distinctly as a narrow belt as far as Vly mountain. North of this hill it disappears against the slates. The belt is bounded by the slates on the west throughout its entire length. Vly mountain is cut off from the main mass by a transverse fault which has offset the main belt to the west by its own breadth. This fault is occupied by a large swamp, to which the eminence probably owes its name. The mountain is bounded on the east by the slates and on the south by the Fishkill limestones. The latter border the main portion of the belt on the east to its southern extremity. The southern end of the strip is faulted against the slates.

Mather called this mass a " granite rock " in his description[1] and in his section the " Matteawan granite " (see plate 12, loc. cit.). He separated it from the gneiss of Bald hill, but apparently regarded it as a part of the Highlands.

E. Emmons[2] cited this rock as an example of the uplift of inferior rocks into the newer ones. He described the relations at Glenham. His section is given herewith.

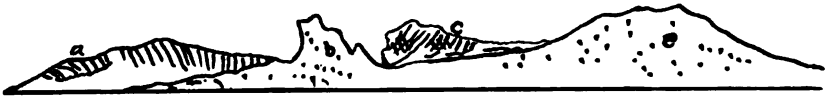

Fig. 10 *a*, slate; *b*, granite (of Glenham belt); *c*, limestone; *e*, Fishkill mountain. (After Emmons)

Hall and Logan, in 1864, called it an ‘altered sandstone,"[3] J. D. Dana, in 1879,[4] referred to it as " bastard granite " and described it as one of the " stratified deposits as is shown by its conformable position and by its taking the color of the slate near its junction." The Highlands were the source.

Smock in 1886[5] expressed doubts of its being stratified. He placed it with the Highlands, though the prevailing types of rock were unlike the characteristic varieties of the Fishkill mountains.

In the southern portion of the Glenham belt the prevailing rock is a massive variety of the granitic gneiss. This is exposed for some depth in the railroad cut west of Glenham station. It is of dark green color and shows scarcely any tendency to foliation. South of this cut and for some distance to the north, surface outcrops are almost always of this type of rock, though varying in the degree of chloritization of the mica. It is without evidence of bedding. This rock grades in places at the south into a laminated finer-grained variety which is common in the gorge of the creek below the railroad bridge at Glenham. At the north this type is more abundant, outcropping frequently between the road from Fishkill Village to Wappinger Falls and Vly mountain.

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[1] Geology of the First District, 1843, p. 437.

[2] Agriculture of New York, Part IV, 1846, p. 103.

[3] Amer. Jour. Sci., Ser. 2, 39:97.

[4] Amer. Jour. Sci., Ser. 3, 27:386.

[5] Thirty-ninth Ann. Rep't N. Y. State Museum, p. 176.

Vly mountain is composed of this variety. It grades into the coarser rock and, like the latter, is usually chloritized, though the red color of the iron usually predominates. The laminations strike between n. 12° e. and n. 15° e. As was noted in the petrographic description of this gneiss, it occasionally passes into a rock composed only of feldspar and quartz.

The varieties so far described make up the surface rock of the Glenham belt and are the ones which have been emphasized by most observers.

The road from Fishkill Village to Wappinger Falls crosses the Glenham belt diagonally about midway of its length. Several shallow cuts have been made in the gneisses along the road. Beginning at the first cut on the south, the section is through about one hundred feet of a coarse, granitic hybrid rock. This is followed by hornblende gneiss and at the top of the hill the latter is succeeded by a banded, slightly crinkled gneiss with pinkish red and dark green laminae. A hundred yards beyond to the north of this rock on the west side of the road is a massive, coarse granitoid gneiss with quartz, light colored feldspar and biotite as the chief minerals. The joints in this rock are filled or faced with epidote. Beyond this is a fine-grained pinkish rock carrying epidote in many places and very similar in essential mineralogy to that described in the Mount Beacon brook section as composing the wall of the gorge above the bridge. Beyond this the cut is for some distance through medium-grained hornblende gneiss exposed on both sides of the road. The last section, on the east side of the road, is mainly through this hornblende rock which shows slight variations and fairly distinct "bedding," with a southeast dip.

These gneisses of the Glenham belt show no distinct types, except as described above for the surface exposures. On the other hand, the hornblende and other gneisses show marked resemblance to the mountain rocks. Roughly correcting the section for the gradient, the bearing of the road and the angle of dip, which seems a little smaller than that of the mountain gneisses, the thickness of the gneissoid types is similar to those observed in the gneisses of the spurs.

The Matteawan inliers. The coarse granitic rock so characteristic of the southern portion of the Glenham belt forms a small inlier farther south in Matteawan. It begins in " Rock Hollow," just west of the intersection of Washington avenue and the road that connects the latter with Liberty street, and extends south across Rock Hollow road (Walnut street) to Anderson street, and then as a narrower strip to Grove street. (See map of Matteawan, fig. 8.) The rock here is not quite so deeply chloritized as in the Glenham belt.

Another mass of similar rock, about 700 feet long by 400 feet wide, lies to the south of this and forms the conspicuous knoll on which the Matteawan schoolhouse stands. The principal outcrops are between Spring, East and Falconer streets. This mass almost certainly connects with the gneisses in the eastern part of the town, but outcrops are concealed along Mill, Louisa and Washington streets and Mountain avenue between this mass and the westernmost outcrop of the gneisses at the east. Limestone may overlie the gneiss in this interval. The latter outcrops between Woodall and Henderson streets, and presumably has or had an eastward extension from here.

The first inlier described above is succeeded at the south by the basal quartzite which forms a knoll between Anderson, Walnut and Grove streets, and is separated from the Precambric on the north and west by Anderson street. The contact could not be found; it may be faulted. The quartzite is overlain by the limestone on the east and south and on the west for a distance of 75 feet north of Grove street. A small mass of slate has been faulted in between the limestone and the spur of the Precambric on the west of Anderson street, near the house of Mrs C. E. Phillips.

At the northern end of the Glenham belt on the southwest side of Vly mountain, north of the road at its base, a small knoll of quartzite, overlain by limestone, has been faulted with the gneiss of the mountain. It is separated from the main mass of foliated, reddish granitic gneiss by a narrow gully.

As noted above, a coarse granitic rock of a mineralogy quite similar to that of the coarse granitic variety of the Glenham belt and the inliers at the south, occurs in places in the bed of Mount Beacon brook above the bridge. It occurs in outcrops among the gneisses in the eastern part of the town and was noted on Prospect street, 50 feet north of its junction with Walcott avenue and at the corner of Vail avenue and Washington street.

The mineral epidote is of frequent occurrence in the Glenham belt and in places among the gneisses in the eastern part of the town of

Matteawan, and the rock which carries it in these different localities is often of very similar mineralogy and appearance in other respects.

Interpretation. The Matteawan inliers connect the Glenham belt with the Highlands in a very satisfactory way. Other field relations which are cited above, show that the rocks composing these inliers are of Precambric age. The banded gneisses seen in the section on the Wappinger Falls road across the Glenham belt, bear strong resemblance to many of the gneisses outcropping in the town of Matteawan along the base of the mountain. The hornblende gneiss in places is identical with those occurring on the road from Brinckerhoff to Johnsville across the Honness spur. When the dip may be observed in the gneisses along the Wappinger Falls road, it is practically the same as that of the Highlands rocks. The essential identity as to the age and fundamental likeness in mineralogy and relations of these inliers with the Highlands is almost certain.

The character shown by the rocks which make up so much of these inlying masses, and upon which most observers have dwelt, apparently admits of ready interpretation.

During the time the early Paleozoic sediments of this region were being laid down the sea was progressively transgressing upon and overlapping the old land mass from which its sediments were derived. This old land mass would doubtless have become decayed for moderate depths beneath the surface, or at least would have suffered some changes in the minerals composing the rock. Where subaerial disintegration actually took place, its products may have remained undisturbed in favorable places, and it is possible to imagine that they were finally covered by the advancing waters without having been much sorted. In other cases they would have been washed away, leaving only the firmer rock, which probably, however, had undergone some mineralogical changes, such as the alteration of its ferromagnesian mineral. In other instances the disintegrated rock would have undergone partial sorting. In other cases it would have been completely sorted and a pure sandstone formed. In some places the advance of the sea would have been rapid enough to leave most of the material unsorted and only a superficial layer of partially sorted stuff. All would probably have been covered finally by a thoroughly worked over quartzitic sand that deepened offshore as the sea advanced.

In the process of time burial in itself would have brought some changes in the subjacent altered gneisses; but the principal ones would have been effected by the same processes that changed the basal sandstone to a quartzite and metamorphosed the overlying limestone and slate. The partly disintegrated upper portions of the gneisses would have been thoroughly indurated into a compact rock and probably partially recrystallized. The less altered gneiss would also have been changed, although not necessarily in such a way as to form entirely new minerals. Chlorite would now appear in a firm rock as a pseudomorph after biotite, or hornblende, and the old iron oxids would have been preserved as magnetite or hematite. In places where alteration had not taken place, the practically unchanged gneiss would be preserved.

It is possible in this manner to account for the peculiar rock types of the Glenham belt and for the occurrence of such features as a coarse granitic " stratum " resting on upturned gneisses and followed by a somewhat foliated, finer-grained, quartzitic rock as shown in the gorge of Mount Beacon brook; or for the occurrence of such extensive surface developments of rock as the chief varieties of the Glenham belt, which so certainly rest upon and grade into the inclined gneisses. Conditions would have been very favorable for the interaction of feldspars and ferromagnesians, which now find expression in the abundant and widely distributed epidote that clearly belongs to an ancient period of alteration.

A relatively large proportion of the ancient altered gneisses has been preserved in the Glenham belt. The section along the Wappinger Falls road, with its assemblage of altered and unaltered types, seems intelligible from this explanation.

At places, as at Vly mountain, and near " Rock Hollow " in Matteawan, fragments of the quartzite have been preserved and these apparently grade into the underlying rock with which they are both unconformable and coextensive.

These principles of subaerial decay have been applied in the foregoing discussion to certain altered gneisses and hybrid rocks occurring in many places among the Fishkill mountains. They serve to account for an evident ancient alteration in these rocks and for the occurrence of certain types that are intermediate in character between the quartzite and the underlying gneiss.

SUMMARY OF THE MICROSCOPIC CHARACTERS OF THE GNEISSES

A microscopic examination has been made of about twenty-five sections of the gneisses of the Fishkill mountains, selected from types which were believed to show the principal variations in the gneissic series from west to east. A half dozen were also selected from the Glenham belt.

These sections, except perhaps, those of the Bald hill granite gneiss and the Shenandoah mountain granite, do not afford any convincing evidence of the original character of the gneisses. They give some support to the inference made as to their alteration and afford some ideas of the age of different characters in the rocks. In instances, they bear out the character as seen in the hand specimen and in the outcrop. In other cases, on account of the coarseness of the rock, they entirely fail to show the megascopic structural features.

There are no striking variations in the kinds of "primary" minerals present, except in the ferromagnesian, although the proportions vary. Quartz is usually present, frequently in large anhedrons only, but oftener both as large and smaller ones. Sometimes it is absent from the section or quite insignificant. Plagioclase is universal, often with orthoclase, but occasionally alone in types with much ferromagnesian content and little or no quartz. Orthoclase is occasionally in apparent excess of plagioclase and microcline is frequent. Biotite often appears alone as a primary constituent, being clearly of the same age as the other essential minerals. Hornblende often occurs alone in the same relationships. Biotite sometimes occurs with hornblende, but then often suggests a secondary character from its distribution and subordinate amount.

Magnetite is abundant and is evidently secondary. It occurs chiefly in irregular grains in bunches or as dust masses in or near the ferromagnesians, or scattered about the section within the feldspars and along fractures. It is occasionally pseudomorphic after the ferromagnesian. The latter are plainly very ferruginous in character. Zircons are numerous and widely distributed. Titanite apparently occurs as leucoxene about the magnetite at times. Chlorite is abundant, often replacing all or most of the ferromagnesians in the section, but this mineral is associated with the gneisses which, in the hand specimen, betray an ancient alteration. Muscovite or sericite occur only as secondary minerals in the feldspar, except possibly in the Shenandoah mountain granite.

The textural features present some variations, but they do not as a rule help much in deciding the question of whether the rock is sedimentary or igneous in origin. Very often the arrangement is very similar to that in plutonic rocks of the granitic or dioritic types and the modifications shown might readily be explained as due to conditions imposed on a magma. Other gneisses, either from a more granular character or from the abundance of the ferromagnesian mineral, suggest altered sedimentary types. But these features are plainly far from decisive. On the whole, the sections are less satisfactory than the field outcrops; but so far as they go they sustain the uncertainty of the field examination.

If these gneisses are mainly altered sediments they have been so thoroughly crystallized that they now often closely resemble igneous types. The hornblendes in their relation to the feldspars sometimes indicate a formation in the usual order of crystallization from a magma. If mainly of igneous origin, these gneisses were greatly squeezed in their formation and would now be more properly designated gneissoid intrusives than intrusive gneisses. In either case the primary minerals (that is, those plainly belonging to the last change that affected the whole rock) and their essential arrangement are of contemporaneous origin.

So far as examined, the sections are entirely free of the minerals usually found in areas of profound dynamic metamorphism. It is, of course, impossible to tell how many complete metasomatic or other changes these rocks may have undergone, but there appear to be no traces of any antecedent generations of minerals.

The sections sustain the belief that the primary features of the gneisses, as a whole, are of very ancient character and of Precambric age. They show, on the other hand, many evidences of subsequent metamorphism.

This later metamorphism is shown in the sections in several ways, but chiefly as pressure effects. In almost all cases the quartz crystals show pronounced strain phenomena, such as strain shadows and wavy extinction, and are often cracked. The plagioclases almost always show pinched-out, bent or broken lamellae. Fractures and long cracks are common. In places where the gneiss evidently had undergone an early alteration, the rock was indurated and occasionally new minerals formed. Some molecular movement is indicated by chloritic fillings, disseminated magnetite and secondary quartz injected into the feldspars. Some biotite very clearly belongs to this later metamorphism.

Some of the sections from the Bald hill gneiss and those in the bed of Mount Beacon brook show fewer apparent strain effects than those from the spurs farther east, which may be interpreted as the expression within these rocks of a somewhat lesser degree of metamorphism at the west. The conclusion that the primary gneissic characters were changed very little in Postcambric time seems inevitable. As the field relations show the gneisses had reached practically their present crystalline condition and gneissic structure in Precambric time. Because of their early crystalline condition, these gneisses would have undergone fewer changes and a relatively lesser degree of metamorphism than the sediments which overlay them, during the mountain building process of Ordovicic time. Such changes as they underwent from this cause should, however, show some correspondence with those in the younger rocks, as is perhaps afforded in the apparent lesser degree of metamorphism at the west. This difference is not, however, noticeable in the field unless the more clearly " bedded " strata in the bed of Mount Beacon brook and the more clearly definable nature of the altered Precambric gneisses of the Glenham belt are indications of it.

An examination of the thin sections of the gneissoid types from the Glenham belt entirely supports the assertion that these rocks are members of the Highlands gneiss series. In mineralogy, texture and metamorphic characters they are entirely similar. The thin sections of the more characteristic types of this belt afford the clue to their interpretation and seem to show their original nature. They also carry characteristic strain effects.

FAULTS IN THE GNEISSES

During the Green mountain uplift the Precambric gneisses apparently buckled somewhat, but seem to have yielded chiefly by breaking. These faults greatly complicate the problem of the configuration of the Precambric land mass while the quartzite was being laid down.

Beginning at the west, the first fault is that shown by the Glenham belt. A reversed or thrust fault has thrown the gneisses against the slates on the west and south. Evidently the slates were folded and overturned and then overridden by the older rocks. The stratigraphic displacement necessary to elevate the Precambric into contact with the slates must have been an extensive one. Apparently at Vly mountain the upthrust was greater, resulting in the elevation of the mountain mass above the main portion of the belt and causing the transverse break between the two. That Vly mountain is not mainly an erosional feature is indicated by its relationships. It forms an isolated block which is faulted against the slates on the west, north and east. The transverse fault on the south involved the limestones which were bought against the slates on the east of them. The gneiss and limestone form the upthrow as a result of reversed faulting, both resting against the slate. The gneiss apparently also moved with reference to the limestone. Projected southward, the fault on the east of Vly mountain falls in line with the scarp on the east of Bald hill (see plate 5).

The gneiss inliers in Matteawan, south of the Glenham belt, are also clearly faulted against the slates on the west. A long swamp borders the northern one of these on the west, while on the north it is in faulted contact with the slates.

The relationship existing between the limestone and the gneiss all along the eastern margin of the Glenham belt and the smaller masses at the south, is far from plain. Although relatively small, there is probably some stratigraphic displacement, in places at least.

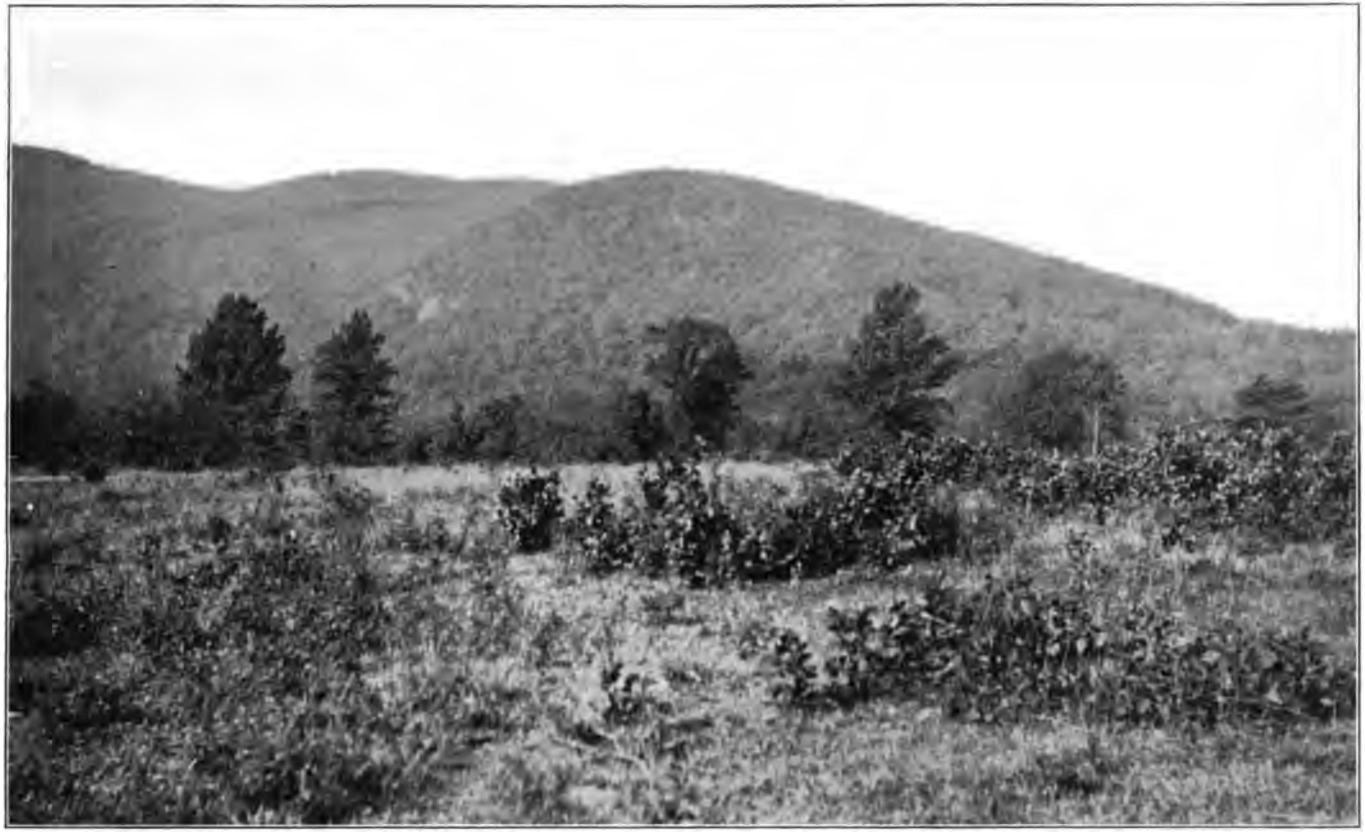
The Bald hill mass shows a still greater vertical displacement. As now uncovered, the break is partly within the gneiss itself and partly along a contact with the limestone, and probably in some places with the quartzite. The slope of the gneiss is always very steep and often precipitous. A moderate slope at the base, in places, may be interpreted as that of the quartzite or the surface from which it has been removed in late geological time. This kind of slope usually changes abruptly to a sharp angle with the vertical in ascending the mountain. The abundant talus at the bases of these scarps is misleading and gives the appearance of a much gentler slope than they really possess. The complementary result of recession of the summits by weathering is also confusing.

Apparently the overthrust which elevated the Bald hill mass involved a larger area of the gneiss. It seems reasonable to explain the faulted contact of the gneiss of the Mount Honness spur and the Fishkill limestone on the northwest of it as primarily due to this thrust. Later or simultaneous tension faulting dropped the limestone east of Bald hill into its present position. A number of scarp faces at different elevations along the northwestern slope of the Honness spur in line with the strike of the gneisses, and visible even in the season of foliage, mark tension strike faulting of diminishing intensity eastward from the great normal fault on the east of Bald hill.

The eastern face of Honness is marked by a rather conspicuous normal fault scarp which diminishes and dies away to the southward (see plate 6). The throw here was not so great as on the east of Bald hill.

Along the west side of the east road from West Fishkill Hook into the mountains, is a drop fault of small displacement. It is marked first by a cliff of the quartzite, but higher up the mountain it is in the gneisses.

Plate 5



Fault scarp on the east of Bald hill

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On the east of the Hook spur another fault of moderate displacement has dropped the quartzite and limestone into the East Hook.

The northwestern slope of Shenandoah mountain is very steep from the point where it cuts the southern boundary of the quadrangle nearly to Shenandoah. The quartzite has a northwest dip of approximately 50°. The gneiss in places shows precipitous ledges, though these are not very high. The angle of slope changes abruptly from quartzite to gneiss. The steep dip of the quartzite shows considerable disturbance before the break occurred.

East of Shenandoah mountain is a clearly defined normal fault scarp along which the younger rocks were dropped. Their erosion has formed Shenandoah hollow.

Along the northwestern slope of the eastern gneiss mass are very steep and precipitous scarps, sharper even than those of Bald hill. The drift-covered talus slopes at their bases are not to be confused with the quartzite. It is probable, however, that in places the quartzite was involved in the upthrow and was brought against the limestone.

These breaks are interpreted as the result, primarily, of the compression producing the Green mountain elevation. The tendency was to produce a system of flexures like those in the younger rocks at the north. The gneisses buckled relatively little but, unable to resist the great pressure, were broken and thrust up into the younger rocks. Tension faulting within the expanded arc accompanied or followed the upward thrusting.

The faulting in the gneisses is clearly subsequent to the deposition of the quartzite. The only disturbance capable of producing these effects would appear to have belonged to the close of Ordovicic time.

These faults would certainly have greatly disturbed any orderly sequence which the gneisses may have had.

SUMMARY AND CONCLUSIONS

The relatively brief treatment of the gneisses of this quadrangle given above results from the impossibility of assembling them into an orderly sequence. The thickly-wooded character of the country, the presence of faults and the difficulties introduced by ancient subaerial alteration, greatly hinder their study and make a satisfactory map practically impossible.

The origin of the gneisses is very obscure. In some respects they appear to be largely igneous in character. In many places their sedimentary origin seems almost certain. It is entirely possible that the two kinds occur together in a parallel and roughly alternate arrangement, but faulting makes it impossible to decide this point in the face of the other difficulties present. The thickness is too great to permit the interpretation of a monoclinal series.

It seems entirely justifiable to attribute the apparent igneous character to profound metamorphism. It is plain that if the gneisses represent a sedimentary series in any part, the strata must have been jammed into close folds and overturned. If folding was accompanied by the injection of igneous rocks along the axes of the anticlines, the accompanying alteration would have been very severe and both sedimentary and igneous types would have come strongly to resemble each other. There would probably be no distinguishable exomorphic and endomorphic effects to aid in separating the two.

The gneisses below the bridge in the Mount Beacon brook section show a " bedded " character more clearly than at any other place.

The general absence of crumpling and crinkling in the gneisses is noteworthy in considering the possibility of their sedimentary origin.

Interbedded limestones, if such could be found, were thought of as likely to afford the most convincing evidence of a sedimentary series in these gneisses. Dr C. P. Berkey has discovered such limestones in the Highlands farther south[1] and in the Fordham gneiss of New York city.[2] The possibility that the basic rock and bastite ledges at Hortontown, described in the following pages, might be altered calcareous and magnesian sediments of Precambric age was considered, but the field relations do not easily permit this interpretation.

Taken as a whole, the gneisses in this quadrangle present sufficient diversity to be considered, at least in part, as an altered sedimentary series.

NAME AND CORRELATION

Dr C. P. Berkey[3] has correlated the basal member of the Manhattan series with the basal gneisses of the Highlands and has

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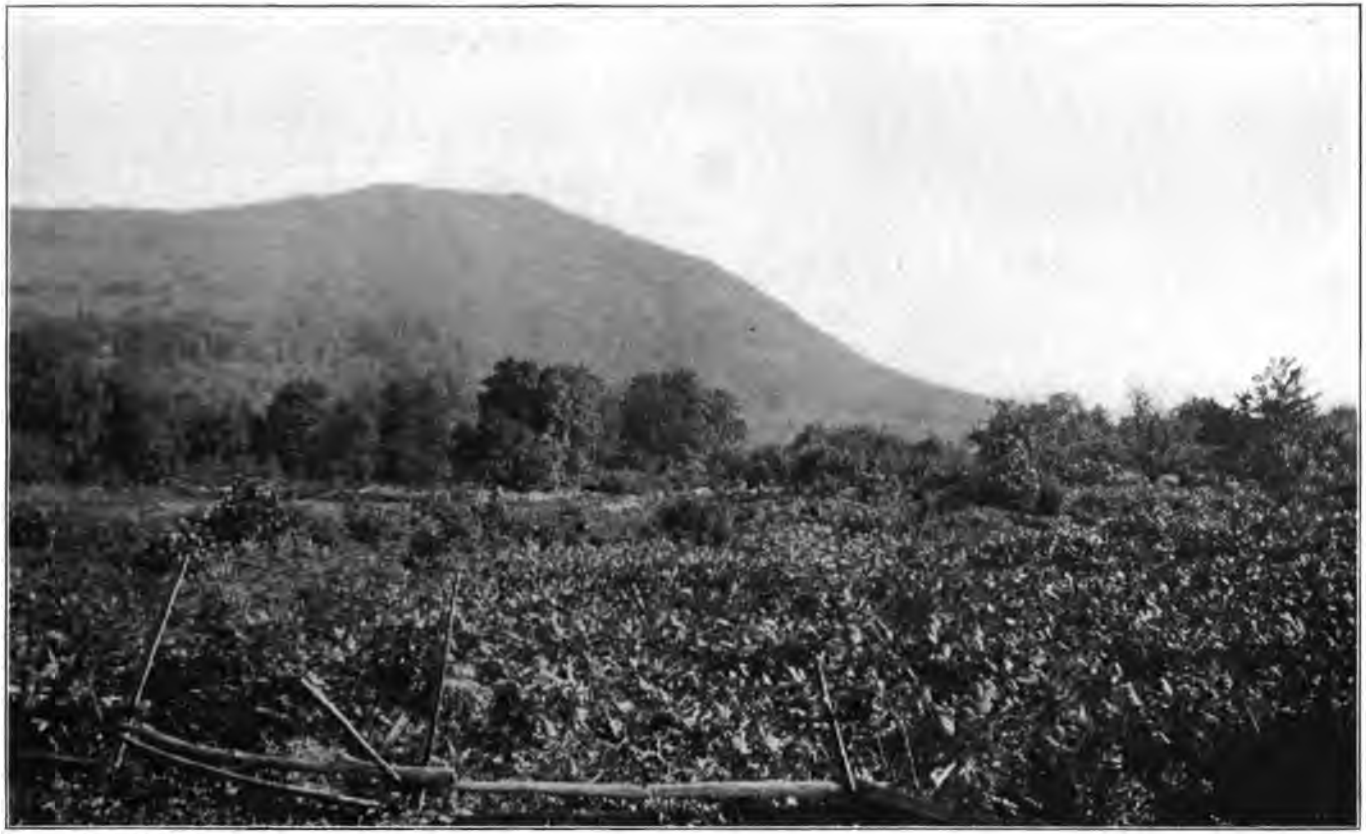
[1] Structural and Stratigraphic Features of the Basal Gneisses of the Highlands. N. Y. State Mus. Bul. 107, 1907.

[2] Science. n. s., 37:936.

[3] Structural and Stratigraphic Features of the Basal Gneisses of the Highlands. N. Y. State Mus. Bul. 107, 1907, p. 361.

Plate 6



Fault scarp on the east of Mount Honness, as seen from the West Hook district

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called the whole the Fordham gneiss. This he correlates with the Grenville of Canada and the Adirondacks.

THE HORTONTOWN BASIC ERUPTIVE AND ASSOCIATED METAMORPHIC ROCKS

General relations. In the orchard by the house and near the barn on the farm of Albert Lawrence at Hortontown, are several outcrops of a massive, compact, greenish rock. One or two ledges are of moderate size, but most of the outcrops are small and inconspicuous. This rock is traceable only a short way to the north or south by actual outcrops, but in the fields and stone walls south of the orchard there are numerous boulders of this rock. The actual ledges disappear beneath the hill to the southwest of the orchard. At the summit of this hill, in a west by southwest direction from the house, and about 200 or 300 yards away, are numerous ledges of a rusty, blackish rock, which may be followed to the southwest for a short distance and then are lost. Just to the west of these outcrops, on both sides of the road and in the road itself, are numerous outcrops of quartzite with southeast dip and a strike east of north. A conspicuous ledge of this quartzite borders the west side of the road. West of this is a gully about 50 or 75 feet in width which at the west is bounded by a perpendicular cliff of the gneisses. The relationships just described are indicated on the accompanying sketch map (see figure 11).

It was not possible to determine the configuration of the mass to which the greenish rock belongs. The east-west distance between outcrops was estimated at 50 feet, but there is reason for thinking that the rock has a greater extent.

Petrography and general description. The greenish rock is very tough. It shows variations from a greenish black rock, streaked with lighter green, through a mottled variety to a lighter, greener rock with a tendency to fibrous structure.

The rock may be cut with a knife. Some varieties, when polished, give a rich, dark, glossy finish. When powdered and tested by the magnet it reveals large quantities of magnetite to which the darker hues are due. Weathered surfaces show freckles of black and greenish yellow, caused by the bleaching of the microscopic crystals among the magnetite grains. The thin section in transmitted light shows innumerable dustings and irregular grains of magnetite, while the rest of the section is yellowish white. With crossed nicols the latter appears as a network of spindles, flakes and needles of bastite. There seems to be no trace of an antecedent mineral (see figure 12).

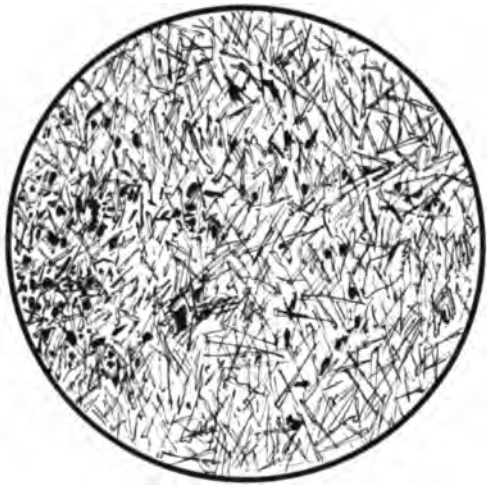

Fig. 12 Bastite rock at Hortontown. Actual size 3 mm. Showing a network of bastite needles and spindles with many grains of magnetite

The ledges of the black rock are prevailingly rusty. Excavation has been made at one place to a depth of two or three feet, apparently in a search for ore.

These ledges are inconspicuous, and, when surrounded and overgrown by grass, are readily missed, except in systematic search.

The hand specimen shows a very coarse texture. The rock is made up chiefly of massive hornblende. There are patches of finer texture in which magnetite is abundant. Small pyrite grains are frequent. In some places the hand specimen shows a relatively porous mass of rounded grains as though some mineral had been dissolved away. The rock has a high specific gravity and in almost all cases is rusty in color. The thin section shows large, irregular pleochroic brown and green hornblendes, with some pyroxene. Magnetite inclusions are numerous and this mineral also occurs abundantly along numerous cracks, sometimes in association with serpentine borders or fillings.

The ledges of the quartzite are more numerous and more extensive than those of either of the other rocks. Its apparent width is about 75 or 100 feet. It is thin-bedded and steeply inclined. It is very similar to the basal quartzite as seen at certain places and appears to belong to that formation. It may be followed distinctly for several hundred feet.

At the north and south these types give way to the characteristic gneisses of the mountains.

The exact field relations of these rocks are very obscure. No contacts could be found. Seemingly the only clue to their age and relationships is to be obtained from the structural features and the associations.

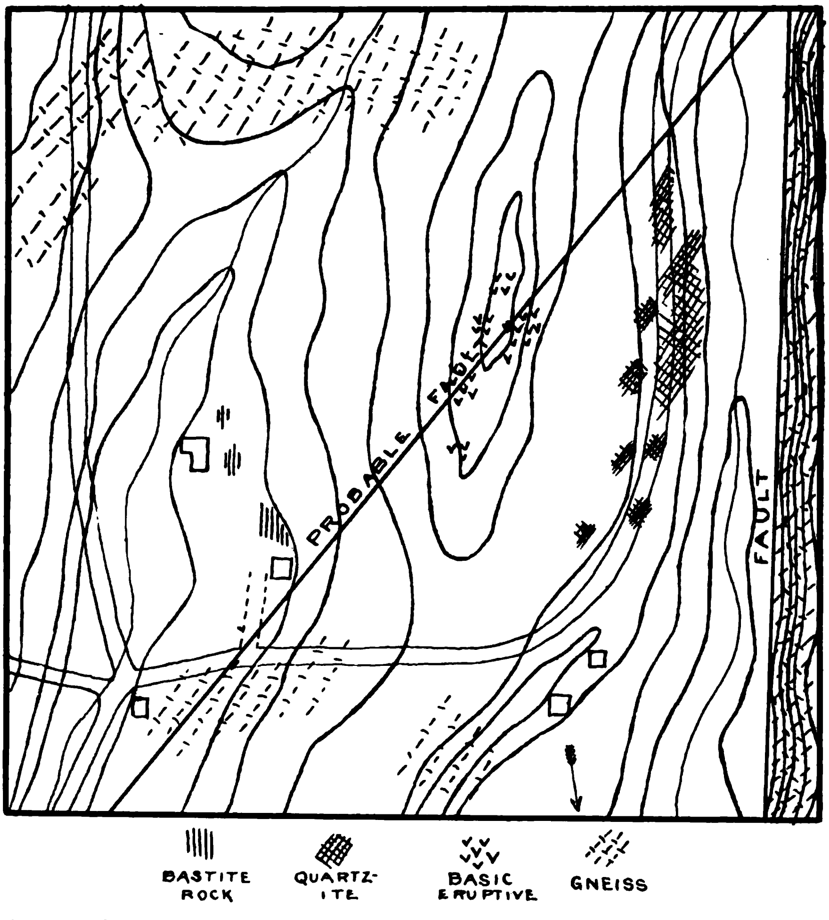

Fig. 11 Sketch map to show the general relationships at Hortontown. Scale approximately 200 feet to the inch.

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ASTOR, LENOX AND
TILDEN FOUNDATIONS

Interpretation. The possibility suggested itself that some of these rocks might be members of the basal gneiss series. The quartzite, however, is almost certainly Paleozoic in age. The black hornblende rock has the characters of a basic eruptive. The green serpentine variety gives little idea of its original character, but it is apparently not an altered pyroxenic rock.

The southwestward continuation of the reversed fault along the northwestern slope of the eastern gneiss mass would apparently intersect the fault on the east of Shenandoah mountain in this neighborhood. The latter scarp is only a short distance west of the quartzite. This intersection would have been a most favorable point for an igneous intrusion. Some of the basal Paleozoics were evidently caught at this intersection and intruded by the hornblende rock. The quartzite offered little for the eruptive to act upon. The bastite rock very probably represents an impure ferruginous dolomite. From what is known of bastite, it is commonly, at least, the alteration product of orthorhombic pyroxene; but the present rock gives no indication of the former presence of any antecedent mineral. There seems to be no grave objection to the inference that the passage was direct.[1]

This is the only occurrence within the quadrangle that permits the interpretation that an eruptive has penetrated and altered the overlying Paleozoics.

THE BASAL QUARTZITE (POUGHQUAG)

Distribution and general structural features. This formation, which has frequently been mentioned in connection with the gneisses, in this quadrangle occurs only in proximity to the Precambric rocks.

In the town of Matteawan the quartzite forms a small inlier as described above, in connection with the first small inlier of gneiss south of the Glenham belt (see page 28). Outcrops were also seen just north of Howland avenue in the open field at the foot of the Mount Beacon incline. The only other outcrops which have been noted in this vicinity occur farther north along the base of Bald hill on the Maddock estate.[2] About 300 yards south of the house and well up in the woods, about 200 or 300 feet east of the private drive, are two or three good-sized ledges. Farther up the hill on Mountain street at the point where it forks, going east, is an outcrop of the quartzite. This was first interpreted as a boulder, but the proximity of this rock in place farther down the hill suggests that it is a small ledge which has been preserved. These outcrops are the only ones which were noted in this town, after a careful search, which were referable to the quartzite as typically developed in this quadrangle.

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[1] Professor B. K. Emerson assisted the writer in the identification of the mineral bastite.

[2] The presence of the quartzite at this point was discovered by a companion, Mr W. R. Clarke.

As has been discussed above, there is strong reason for thinking that certain phases of the gneiss owe their peculiar character to the subaerial decay and partial sorting which took place during the epoch of the transgression of the sea in which the quartzite was laid down, and are therefore of the same general age.

At Vly mountain a small patch of the quartzite has been preserved just north of the road on the south side of the mountain at the summit of the hill as the road descends into the swamp, going west.

A careful search was made along the northwestern base of Bald hill from the Maddock farm to the northeastern end of the spur. The topography between the more precipitous portion of the hill and Fishkill creek often suggests the presence of the quartzite. Outcrops are few and the gentler basal portions of the slope are usually drift-covered. The foliated Bald hill gneiss outcrops in places north of the Maddock residence between it and the farmhouse at the northeast. Outcrops are absent at the base of the gneiss to the northeast of this farm, nearly to the end of the spur. The ledges of gneiss often rise precipitously from the edge of the gentler portion of the slope and the bases of the scarps are hidden by abundant talus which, in many cases, doubtless forms the gentler slopes. Near the extremity of the spur, due south from Fishkill Village, a ledge of the quartzite was discovered in the woods near the edge of the gneiss. The gneiss extends to the north of this ledge.

The Bald hill thrust carried the quartzite with it in places before the rupture occurred and in these places a characteristic quartzite slope has been preserved. Only a few scattered ledges now mark the former presence of this formation in the eastern part of the town of Matteawan. The small ledge near the extremity of the spur seemingly belongs with the upthrow block and probably rests by thrust against the limestone. It is a question whether the precipitous ledges of the gneiss northeast of the Maddock farmhouse rest against the quartzite or the limestone.

The map represents the quartzite slope, with the break to the southeast of it passing into the limestone southwest of the Maddock farmhouse. Northeast of that point it shows the gneiss against the limestone for a distance as indicating the tendency of the thrust, and then against the quartzite, with a probable break between the quartzite and the limestone.

There are no traces of the quartzite south of Fishkill Village in the valley of Clove creek, nor along the northwestern base of the Honness spur. Along the northwestern base of Mount Honness proper the gneiss is only 50 or 100 feet from the limestone, from which it rises in bold ledges. The quartzite may once have covered a portion of the northwestern slope of this spur.

East of Honness, about one-third of a mile south of Johnsville, the compact quartzite with some conglomerate outcrops for a short distance in the woods at the base of the scarp, but is soon lost beneath the kames which rest against the cliff. South of these kames on the farm of Irving Knapp, as mentioned above, a large mass of rock with northerly dip forms conspicuous ledges in the east fork of the mountain roads. It resembles both the quartzite and the gneiss and probably represents a transition from one to the other. The quartzite outcrops along the road east of Knapp's, in one or two places, but is mostly concealed by drift west of the west road from the Hook into the mountains. It was found in the bed of the brook just west of John Ireland's house and about 300 yards south of the Thomas Carey farm on the roadside just above the brook. Some conglomerate occurs at this point. Eastward from the Carey farm, on the farms of Garrett Smith and Ward Ladue, it forms large conspicuous ledges and extends to a point one-fourth of a mile south of Garrett Smith's and terminates with an abrupt talus slope in the woods. The unconformity between the quartzite and gneiss is plainly shown just south of Alonzo Smith's (see plate 4). East of the east road into the mountains, the quartzite extends a little farther south before the gneisses are reached. The southern boundary swings round northwest of the McCarthy place and then east through the woods across the Hook spur to the fault on the east of this. At this point the quartzite was dropped by a fault and is now concealed by surface deposits nearly to the quadrangle boundary. Just north of the road on the west side of the brook it appears in large ledges. Low ledges of limestone outcrop in the meadow just east of the brook.

Near the quadrangle boundary a small brook, which comes down from Shenandoah mountain, has cut through the surface deposits.

The quartzite was found exposed well up the slope in the bed of this brook dipping [illegible] to the northwest with a strike of n. 49° e. following closely the strike of the ridge. For a mile and a half to the northeastward this formation forms a clear topographic feature, though concealed by drift. Farther on it outcrops frequently and in large ledges along the south side of the road from the East Hook to Shenandoah. It crosses the road less than one-fourth of a mile west of that hamlet and is succeeded by the gneisses. There are numerous outcrops of the quartzite just north of Shenandoah. It is probably cut off at the east by the fault that borders the mountain on the east.

The quartzite is absent along the eastern base of Shenandoah mountain until one reaches the mass associated with the basic eruptive at Hortontown (see page [illegible]).

Along the northwestern slope of the eastern gneiss mass the topography from the schoolhouse near Hortontown to Fowler's kaolin mine suggests the presence of this formation. The quartzite was not found and the lower portion of the slope is covered with drift which contains frequent large quartzite boulders. The kaolin rock at Fowler's mine may represent the quartzite. It seems likely that the gneiss rests against the limestone southeast of Shenandoah, and that the quartzite has since been eroded. South of the junction of the Hortontown and Mountain roads, gneiss is the outcropping rock in the valley of the brook as far as Hortontown.

Along the slope of the eastern mountain mass, northeast of the kaolin beds and the ore deposits, everything is beneath the drift for a long distance at the base of the mountain. The gentle slope which is present is probably due to talus. No outcrops of the quartzite were found. South and southeast of Charles E. Bailey's the limestone is only a short distance from the precipitous gneiss. Just north of the road at the base of the mountain scarp, east of Bailey's, a wide swamp extends northeastward. Three-fourths of a mile east of the point where this road turns southward into the mountains the quartzite was found in good-sized ledges within the edge of the woods.

The conditions along this slope resemble those described for Bald hill. There was a tendency for the quartzite to fold somewhat before the rupture occurred, and the slope of the hill marks the slope of the quartzite as seen southeast of Shenandoah. Toward the northeast the rupture occurred earlier, so that the gneiss now stands in precipitous ledges against the limestone. Farther on, east of Bailey's, the quartzite was brought against the limestone marking a diminishing tendency in the thrust to the east. As shown on the map portions of the quartzite are yet preserved near the quadrangle boundary. Where the quartzite could not be found the gneiss is represented as resting against the limestone; but in some cases, as discussed above, the quartzite may have once been present.

The wide swamp east of Bailey's marks the northeastward continuation of the great thrust fault along the limestone-quartzite contact.

Petrography and general description. This formation has great uniformity of appearance and general character throughout the area. Its principal variations may be stated very briefly. The predominating variety is a compact, granular quartz-rock of medium grain. This grades into a fine conglomerate at the base in a few places and in others at the top into finer-grained quartzitic shales. The predominating variety is either white or pinkish in color. Feldspathic varieties are rare.

Within the quadrangle there does not appear to be any appreciable difference in metamorphism in this formation from west to east. At the type locality at Poughquag there is indication of a gneissoid character. Within this quadrangle the quartzite apparently never was involved violently enough to induce this structure.

The thin-bedded varieties, often with shaly character, were noted at the northern end of the Hook spur south of the Hupfel estate, in the steep bed of the brook in the East Hook near the quadrangle boundary, north of Shenandoah and at Hortontown. Conglomeratic phases were seen southwest of Johnsville near Honness mountain, south of the Thomas Carey farm in the West Hook and north of the McCarthy place to the east of Ward Ladue's.

Strikes and dips in this formation vary greatly. In Matteawan good observations could not be made in the thick quartzite south of Anderson street nor at the foot of the Mount Beacon incline. Readings taken just south of the Maddock residence gave a strike of n. 75° e. and a dip of 54° n. w. The gneiss, only 30 feet away, dipped 50° to the southeast. Observations at the quartzite ledge at the extremity of the Bald hill spur gave a strike of n. 42° e. and a dip of 48° to the northwest. A reading taken on the east of Honness gave a strike of n. 42° e. and a dip of 35° southeast. South of the Carey farm in the West Hook the dip is 15° to the northeast. On the farms of Garrett Smith and Ward Ladue, west of the fault, the dip is to the northwest. East of the fault it is to the northeast. As the boundary swings round the western slope of the Hook spur, the dip changes from northeast to north and northwest, and at the northern end of the spur from northwest to north. On Shenandoah mountain in the East Hook, near the quadrangle boundary, the strike is n. 49° e. and the dip 50° n. w. This general strike and dip holds to Shenandoah. North of Shenandoah the dip changes to north. The quartzite disappears at the east under a mass of kames. Readings made a mile east of Bailey's gave a strike of s. 70° e. and a dip of about 18° n. e.

The quartzite thus follows the folds of the gneisses and, although eroded and disturbed by faulting, tends to fringe the spurs and hollows along the northern margin of the Highlands.

The conformable series at West Fishkill Hook. East of the normal fault that extends along the east road into the mountains, the basal quartzite is overlain by bluish-gray limestones having the same dip as the quartzite. The nearest approach to actual contact is in Ward Ladue's orchard, a few feet north of Jones's barn. The pinkish ledges of granular quartz rock are only a few feet away from the limestone and the two are seen to be in strict conformity. The limestone, which is greatly broken up into large blocks, can be followed to the south and east. In both directions it is succeeded by the quartzite. The limestone swings round the northwestern slope of the Hook spur and appears in numerous ledges in the fields southeast of W. L. Ladue's barns. Here it is conformably overlain by gray calcareous shales. At the eastern side of the pasture, south of the orchard on W. L. Ladue's farm, the shales dip to the northwest and north. A little farther west, in the center of the field, the interbedded shales and shaly limestones have buckled into a low anticline.

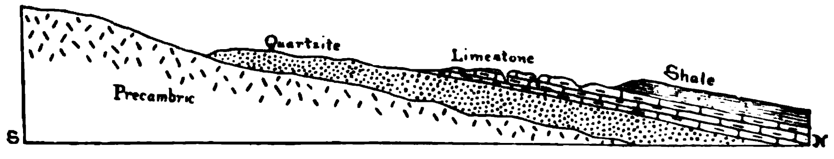

Fig. 13 Generalized section to show the conformable series of the Lower Cambric in the West Hook district. Distance approximately one-third of a mile

Fossils from the quartzite and overlying limestone. With the exception of a few worm borings found in the quartzite along the west road from the West Hook into the mountains in the summer of 1906 (see figure 14), fossils had not been discovered in this formation up to the summer of 1909.

In August of that year the writer discovered in the yard of Ward Ladue at the West Hook a fossiliferous slab of compact quartzite, about three feet square, and plainly derived from a bed about five inches thick. Both surfaces were covered with fossils, chiefly brachiopods and the cephalic borders and spines of trilobites. Some of the latter were from one and one-half to two inches long.

This slab was from a fine-grained, gray quartzite bed and was very compact and resistant. The fresh surface showed numerous rusty markings.

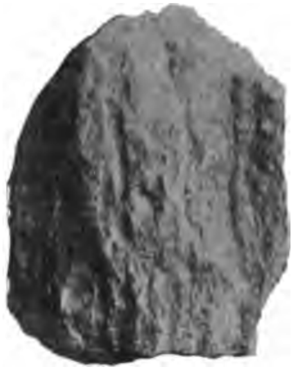

Fig. 14 Worm borings in Lower Cambric quartzite

This discovery led to persistent search for the fossiliferous rock in place.

Directly south from Ward Ladue's house a gorge in the quartzite apparently marks the beginning of the normal fault displacement that extends southward just to the west of the public road. The western wall of this gorge is composed of thickly bedded compact quartzite. The eastern wall shows thinner rusty layers interbedded with the compact rock. The fact that only a hundred feet or so to the eastward the quartzite is overlain by the limestone, together with the evidence of faulting, were taken to indicate that the rocks in the eastern wall are younger than those on the western or upthrow side. With this assumption as a basis, and in the belief that the rusty layers interbedded in the superficial portion of the quartzite should yield fossils, if such were present, the eastern wall was given a very careful examination. No fossils could be found between Ladue's and the point where the gorge intersects the road. Although the dip of the quartzite is very gentle along here, the thickness crossed is considerable.

The gorge was then traced southward from the road. A rich assemblage of fossils was discovered in the eastern wall about 250 yards southeast of Herman Adam's house. The ledge occurs just beneath an old stone wall that separates the gully from an old orchard. The fossil traces were first discovered in the compact rock similar to that seen in the slab in Ladue's yard, and showing the same rusty markings on the fresh surface. This rock overlies some thinner, rusty, decomposed layers in which fragments of trilobites and brachiopods are very abundant. The trilobite fragments are smaller than those displayed on the slab described above, but in other respects are quite similar. They were identified as fragments of Olenellus, probably thompsoni. The brachiopods bear a strong resemblance to Obolella. Two specimens of the rusty quartzite crowded with fossils are shown in figure 15.

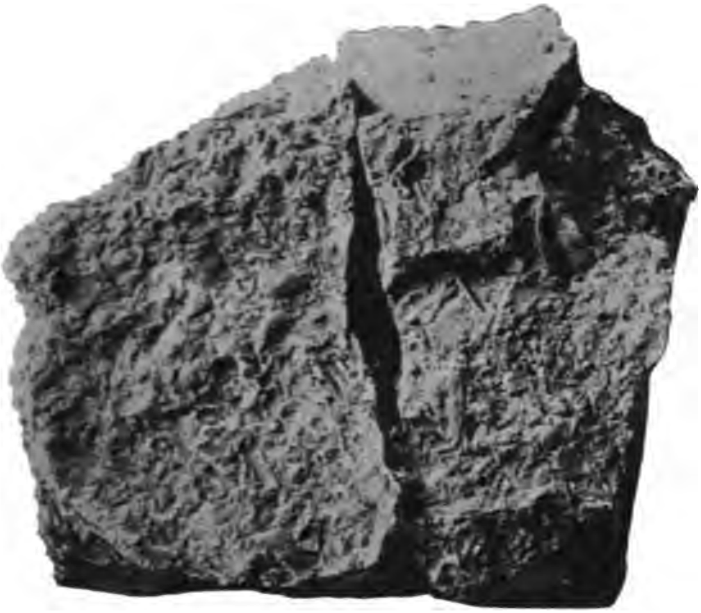

Fig. 15 Fossiliferous Lower Cambric quartzite

In the summer of 1908 the opercula of Hyolithellus micans were discovered in the limestone overlying the compact quartzite in Ladue's orchard at an estimated distance of 20 feet above the latter. After a careful search another operculum was found at a slightly higher level in the first ledge east of the lower barn on Jones's farm.

Age and correlation. These fossils prove the quartzite to be of Lower Cambric age. The similar relations which it has to the underlying gneiss indicate that it is the equivalent of the basal quartzite at Poughquag. The latter was described and named by Prof. J. D. Dana[1] as the Poughquag quartzite.

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[1] Amer. Jour. Sci., Ser. 3, 1872, 3:250-56.

Summary and conclusions. The relationships among the quartzite, limestone and calcareous shale described above are exhibited nowhere else in this quadrangle.

The field relations of the gneisses and the quartzite indicate that the older rocks have been thrust up into the younger series and that in general their present relative position must be regarded as very different from that which obtained when the Cambric sea overlapped the older land. It is plain that the quartzite was involved in the thrust movement and, although never violently folded, was yet greatly disturbed by folding in certain places. In many instances the quartzite was moved bodily with the gneisses, so that where it is now present, or was apparently present up to a comparatively recent epoch, it is not contiguous with the limestones of its own epoch, but with later ones on which it has been thrust.

A not unreasonable restoration of the Precambric floor, which is thus assumed to have been fractured and elevated, would allow a considerable extension of the thick quartzite formation southward from its present northern position. The actual evidence for such a former extent consists in the faulted mass at Hortontown, which, since the thrust movement was northwestward, could hardly have had an original position farther northwest, but which might readily have come from the southeast, and in occasional ledges observed in the woods during a reconnoissance south from West Fishkill Hook across the quadrangle boundary. The character of the slope of the quartzite where least disturbed, as in West Fishkill Hook, its thickness and the rather steep southern termination at certain places, indicate a former southward extension.

The varying strike and dip of this formation is best interpreted as the result of disturbance subsequent to its deposition, rather than to original initial slope.

In attempting to explain the present valley position of the younger rocks along the northern border of the Highlands, instead of assuming that they were deposited in valleys, we are offered the alternative explanation of down-faulting, and subsequent partial or entire erosion in which the ice sheet may have played an important part.

The Precambric masses may have stood as islands in the early Paleozoic sea, but the present relationships do not require such an interpretation.

The disturbance of the quartzite has given it such inclination that it might be regarded as of different geological age at different altitudes. Of this there is no evidence.

THE WAPPINGER (BARNEGATE) LIMESTONE

This formation appears within the quadrangle in two main belts with some smaller faulted masses lying between them. The westernmost main belt is the Barnegate limestone of Mather,[1] but now commonly referred to as the Wappinger creek or New Hamburg belt. It is followed by Wappinger creek from the latter's source near Pine Plains to the Hudson river, and its eastern contact with the overlying "Hudson River" formation crosses the river at New Hamburg. The eastern belt is known as the Fishkill limestone, as it lies chiefly in the town of old Fishkill.

THE WAPPINGER CREEK BELT

This belt enters the quadrangle from the north at Pleasant Valley and continues in a southeast by south course to New Hamburg. It reappears west of the Hudson and continues in the same direction beyond the western boundary. East of the Hudson it is broken up into a central strip, with a large rectangular strip on the west of this along its southern half and separated from it by a narrow band of the slates, and several smaller masses lying to the east of the central strip along its middle portion.

THE WESTERN STRIP

Boundaries. This strip is clearly faulted against the slates at the north. The fault line runs in a southeast-northwest direction across the Poughkeepsie driving park. The western contact is marked at many places by swamps or scarps which indicate that the western margin is also a faulted one.[2] The presence of a fault along here receives confirmation from the apparent age of the limestone in contact with, or in proximity to, the slates. The western boundary begins just southeast of the junction of Hooker avenue and the road that runs southward from it on the west of the driving park and passes across the northwestern part of the Ruppert farm and just west of the old Hinckley house, and then may be traced by swampy ground or a low scarp to the schoolhouse at the corner of the Spackenkill and Poughkeepsie roads; thence under drift to the first road leading to the river. The limestone outcrops on the north side of this road in low-lying ledges and in more conspicuous ones south of it in proximity to the slates. From here the contact is indistinctly followed to the river, where the limestone terminates in a bluff. The northern portion of its eastern boundary is concealed by drift, but farther south to the east of the road that runs southward on the east of the driving park the limestone forms a conspicuous feature for several hundred yards along the eastern edge of R. J. Kimlin's farm. Southwest from here it apparently follows Casper creek to the Hudson river. The slates which come in between it and the central strip form conspicuous ledges both north and south of the Spackenkill road and were noted southwest of the Poughkeepsie-Wappinger Falls road, on the east side of the road to New Hamburg, and also near the Hudson river. The lower reaches of Casper creek, west of the Poughkeepsie road, are choked with kame deposits.

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[1] Geology of the First District, 1843, p. 410.

[2] This fault was described by Professor W. B. Dwight. See Amer. Jour. Sci. Feb. 1886, 31:125-37, with map.

Terranes present. The Potsdam and Trenton horizons have been recognized in the strata composing this western strip of limestone.

The Potsdam. Fossils belonging to this horizon have been discovered in a few places. The first were reported by Professor W. B. Dwight[1] from the northern portion of the strip. Just south of the Poughkeepsie driving park, and to the west of the new private road which runs south from the park to the Ruppert farmhouse, are a number of low-lying ledges. They have yielded: "Lingulepis pinniformis, L. minima, L. acuminata, Obolella (Lingulella) prima, Obolella . . . resembling 'nana,' Platyceras, Ptychoparia (Conocephalites) n. sp. Dicellocephalus, Ptychaspis, Stromatocerium, encrinal columns." A few months later Professor Dwight reported other Potsdam fossils from a locality about a mile southeast by south on the Spackenkill road, about one-half mile east of the Ruppert farmhouse, at the point where the private road to the Varick farm leaves the main road. In addition to Lingulepis pinniformis and allied species found at the first locality, he identified Ptychoparia saratogensis Walcott, and P. calcifera Walcott.[2] These fossils may be seen in the museum of the Vassar Brothers' Institute at Poughkeepsie. Another ledge yielding L. pinniformis was found by Professor Dwight near the eastern margin of the belt about one-half mile southeast of the first locality described.[3] This ledge is just east of the little house north of Mr R. J. Kimlin's barn. The ledge carrying Solenopora compacta found by Professor Dwight is only a short distance to the southeast.

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[1] Amer. Jour. Sci., Feb. 1886, 31:125-37. See also Trans. Vassar Bros. Inst., 4:130-41.

[2] Trans. Vassar Bros. Inst., v. 4, pt. 2, p. 206-14.

[3] Amer. Jour. Sci., July, 1887, 34:28-32.

In the summer of 1908 a new Potsdam locality was discovered by the writer. The beds yielding fossils were found in the quarry on the Ruppert farm about 200 yards north of the Spackenkill road. The rock was being removed for lime and blasting operations greatly facilitated the search for fossils. These are scattered and usually fragmentary. They are embedded in compact, resistant limestone which made the search difficult. A half dozen good specimens of Lingulepis pinniformis were found, besides numerous fragments; also a head of Ptychoparia sp. A photograph of the quarry is shown in plate 7. Fossils seemed most abundant in the middle layers. Figure 16 shows two of the best preserved specimens of L. pinniformis.

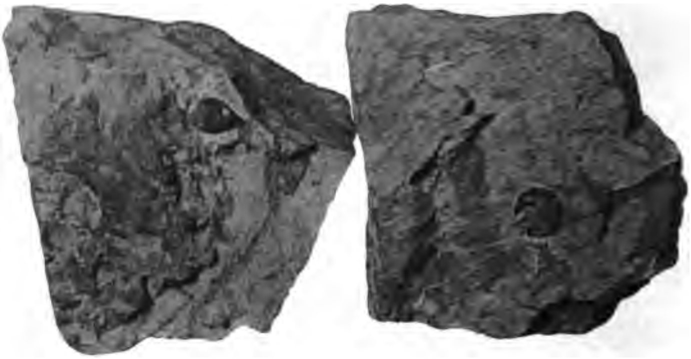
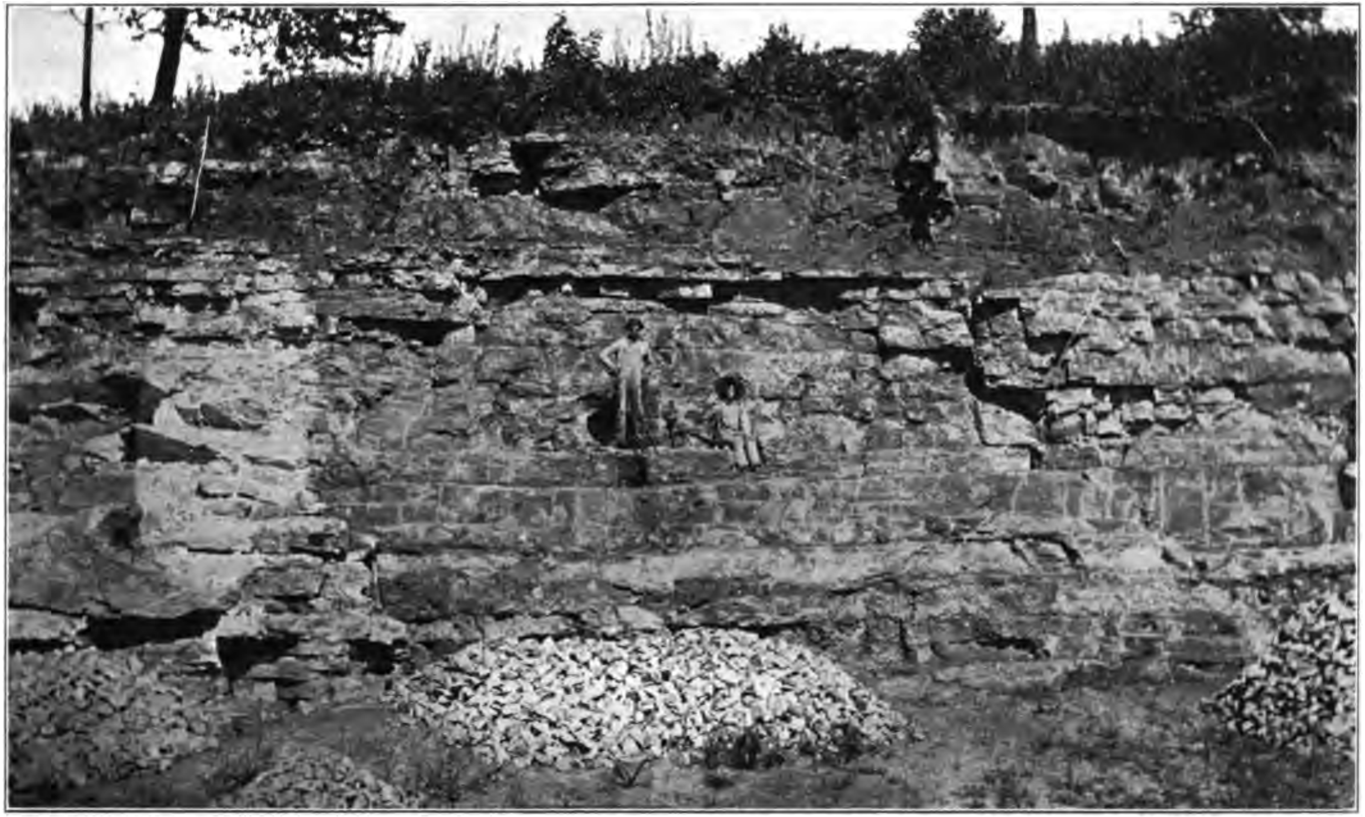


Fig. 16 Two specimens of Lingulepis pinniformis from the arenaceous Upper Cambric limestone beds at Ruppert's quarry

The rock in the floor of this quarry showed many peculiar markings of concentric rings from three-fourths to one inch in diameter. These were sectioned and examined by Professor John M. Clarke. A part of a letter from Dr Clarke referring to these structures is given below.

" I have had the specimen you sent to me cut and polished in the hope of bringing out some structure from the concentric masses therein. The result is not very satisfactory, except as indicating what seems to be an inorganic origin, though I would not be willing to say that the masses were not spongoid like Streptochaetus. The successive laminae might indicate such a structure, but the intimate composition of the skeleton has been so altered by granulation as to seem to leave possibility of organic structure pretty hazy; yet I am inclined to believe that the rock carries organic remains, as

Plate 7



Showing the almost horizontal Upper Cambric beds in the quarry at Ruppert's farm southeast of Poughkeepsie. These beds dip slightly to the west. The middle layers have yielded Lingula pinniformis and Ptychoparia sp.

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indicated by apparent fragments of shells seen on polished surfaces and in section. I return these specimens to you for your examination. I notice that one side of the rock specimen exposes something that suggests a head of Conocephalus or other primitive trilobite."

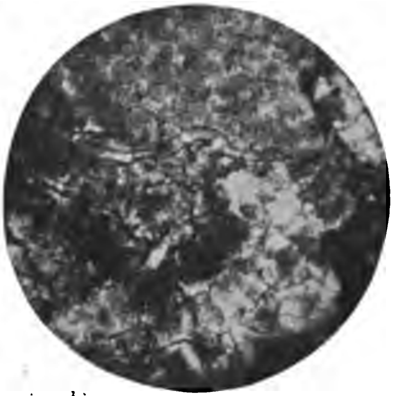
Fig. 17 Showing a thin section of the limestone in the floor of Ruppert's quarry

Figure 17 is a photomicrograph of a section of this rock and shows what appears to be a fragment of a tiny shell. The microscope failed to bring out any structure in the concentric masses.

In addition to the suggestive marking referred to by Doctor Clarke as possibly representing a trilobite cephalon, the writer noted another strongly suggesting a Hyolithes.

The rock layers in the floor of the quarry are about ten or twelve feet below the layers yielding L. pinniformis and the whole are conformable.

The Trenton. This horizon, as mentioned above, was reported by Professor Dwight from the eastern margin of the belt on the farm of R. J. Kimlin and was recognized by the presence of Solenopora compacta. No other localities have been described.

Petrographic characters and further description. The Potsdam rock in the locality first reported by Professor Dwight was described as varying from a tough compact limestone through fissile, shaly argillaceous types and arenaceous and oolitic limestones, into quartzitic varieties which were sometimes brecciated. All were calcareous. These may be verified for the most part. The calcareous quartzite is often friable from the loss of the carbonate and rusty from iron discoloration. It frequently carries shell-like depressions or molds. Along the western margin of this strip large quantities of sand are dug and shipped away for molding purposes. In appearance, it strongly suggests the rusty quartzitic phase of the Potsdam of this western strip. As favorable a place as any for observing this sand is on the farm of Mr Toel on the Camelot road north of Casper creek.

A section beginning at the eastern margin of the belt, just southeast of R. J. Kimlin's farm, and running west along the Spackenkill road to the Poughkeepsie road, and then continued to the river along the road to the molding sand dock a mile and a half north of Camelot,[1] and thence along or just east of the track to Camelot station gives all the principal varieties of rock that have been met with north of Stoneco quarry.

Beginning at the east, south of Kimlin's farm, at the top of the hill on the Spackenkill road, the rock in the ledges is of a light steel-blue color and of medium grain (letter A in the section, fig. 18).

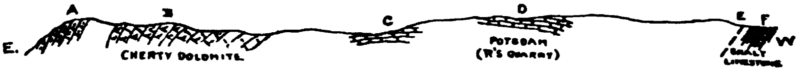

Fig. 18 Section along the Spackenkill road

It often carries on fresh surfaces markings of calcite, shaped like the segments of various curves, and blackened depressions and pits which have no particular or definite form. Just north of the junction of the two roads at this point on the east side of the road that passes Kimlin's house a brecciated conglomerate was noted resembling the Trenton as seen elsewhere in the quadrangle and carrying masses that resembled Solenopora compacta.

The next cut west on the Spackenkill road shows many chertlike masses and scroll effects of silicious material that have weathered out. North of here in the fields of Mr Mulkemus and in the neighboring woods the ledges carrying this variety of rock are very numerous and may be traced some distance east and west (lettered B, fig. 18).

This rock gives place, near and at the junction with the Varick road, to dull gray ledges of arenaceous limestone which has a coarse sandpaperlike appearance on weathered surfaces. One-fourth mile beyond this, rock outcrops on the north side of the road and lies quite flat (lettered C, fig. 18). The rock at Ruppert's quarry, one-fourth mile farther west (lettered D, fig. 18), in general character is almost identical with that of the two previous outcrops. The rock in the quarry varies in color from black to gray. The beds average thicker at the base and grow thinner toward the top. There are a few shaly layers. The strike of the quarry rock is about n. 75° e. and the dip about 10° northwest.

At the corner of the Spackenkill and Poughkeepsie roads impure limestone outcrops on the east side of the latter road with a strike of n. 23° e. and a dip of 70° s. e. This may belong with the slate formation and may therefore be on the downthrow side (lettered F, fig. 18).

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[1] Camelot station is at the point marked Stoneco on the map. The name Stoneco is usually applied to the Clinton Point Stone Company's quarry, a mile below Camelot station.

Ledges of rock similar to that in Ruppert's quarry occur to the southeast along the western margin of the belt, to the north and south of the first road leading to the river, and west of the road leading from this toward Camelot station. East of Camelot station, about 100 feet up the hill, on the south side of the New Hamburg road, ledges of rock identical with that in Ruppert's quarry strike approximately east and west and dip about 12° to the south.

The first road leading to the river, south of the Spackenkill road, leaves the Poughkeepsie road (old Albany turnpike) one-fourth mile south of the schoolhouse. The river road gives off two branches, the shorter, lower one going to the dock of the Whitehead Sand Company and the other to Camelot station.

On the east side of the lower road, just north of the red house, coarse conglomerate, familiar in Trenton localities within this quadrangle, outcrops in one or two large ledges. This rock, in a brecciated condition, was also noted farther south along the upper road where this runs parallel with the railway track, about one-fourth mile north of Camelot station.

Along the middle portion of this western strip the topography generally indicates a very gently sloping almost flat substratum of rock, and the extraordinary width of the belt is plainly due to the nearly horizontal position of the underlying strata for long distances.

The varieties of rock described by Professor Dwight would seem to be accounted for mainly as outcrops across the dip of several beds showing variations of texture and composition, and partly to the different effects of weathering on these, as well as to possible frictional brecciation.

The portion of the section which may be seen at Stoneco in the quarry of the Clinton Point Stone Company is between one-fourth and one-third of the breadth of the strip from its eastern margin and displays a thick mass of dolomitic limestone dipping gently to the west (see plate 8). For the most part it is thick-bedded. There are some thinner layers near the top and in the middle. Some beds carry numerous chertlike masses and in this particular, as well as in

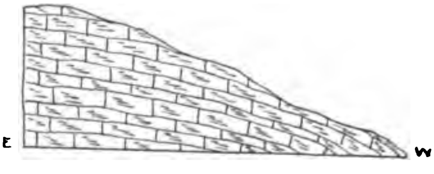


Fig. 19 Section at Stoneco quarry

general character, the rock strongly resembles the variety described above along the Spackenkill road on the farm of Mr Mulkemus near the eastern margin of the belt. No fossils were found in the beds of this quarry and hence no definite idea of its age could be obtained.

Just east of Camelot station, as described above, arenaceous limestone identical with that in Ruppert's quarry, dips to the south at an angle of 12°. This suggests a southward pitch and a superior position for the strata in the Stoneco quarry, a mile to the south of Camelot.

The stratigraphic position and estimated thickness of the Stoneco beds agree with those of the cherty rocks along the Spackenkill road to the northeast. Presumably these strata once entirely covered the Upper Cambric (Potsdam) along the central and western portions of the strip and have been preserved at the south on account of the pitch of the series.

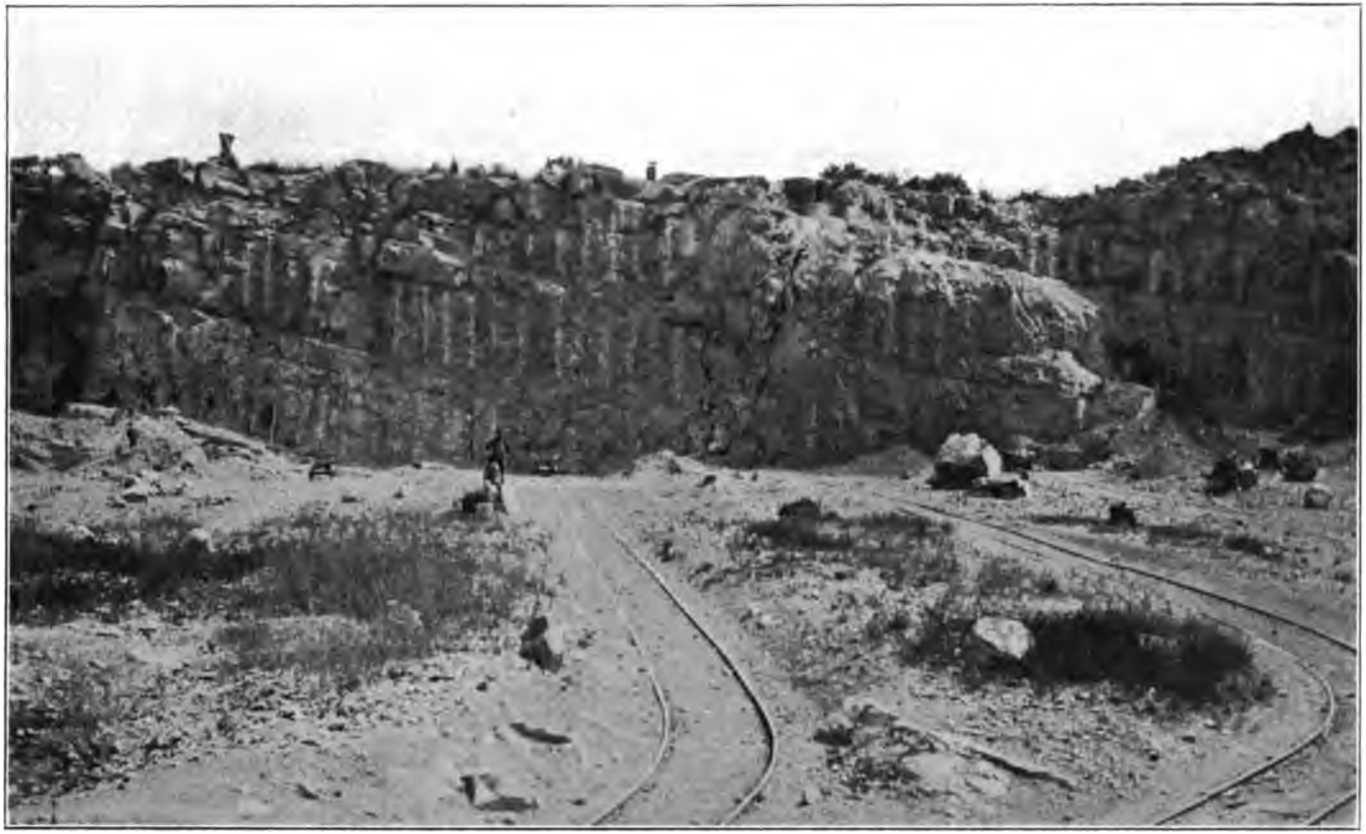
Structural features. It is not possible to tell with absolute certainty what the exact relationships are among the different strata composing the series of this western strip. Presumably the Upper Cambric beds are followed conformably by those which apparently have a superior stratigraphic position. But in these latter strata it is necessary to recognize a probable interval of erosion as is indicated by relationships which can be determined with more exactness within the central strip and which is shown by the presence of a conglomeratic layer, even in this western belt. As will be discussed farther on this conglomerate, though possessing peculiar features, marks a change in fauna as well as in the lithic character of the rock and must be taken as marking a definite hiatus.

The present almost horizontal position of the Upper Cambric and overlying beds theoretically admits of two explanations. It either represents a close overturned, recumbent fold, or else a reversed fault accompanied by westward thrusting, which was preceded by only relatively little folding.

These rocks show no indications of extensive slickensiding, of compression of layers, or of flow structures such as would be expected in violently folded strata. There is evidence of some brecciation and slipping in the rock along the eastern margin, but this is not severe. There is extensive fracturing which is, however, readily explained by the hypothesis of reversed faulting and thrusting.

The field relations point to an upward movement of older strata into overlying younger ones similar to that already described for

Plate 8



A portion of the southeast wall at the quarry of the Clinton Point Stone Company, Stoneco, showing the thickly bedded limestones dipping to the west

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the gneisses. Along the western margin of the strip the compression brought the Upper Cambric beds against the slates, which were first folded and overturned and then overridden. At the quarry at Stoneco and below Marlboro station across the river the westward dipping younger strata show a diminution in the upward thrust toward the southwest which may be associated with an earlier release that elevated the Glenham belt.

As already indicated, the conglomerate appears in places along the western margin of the strip. It is best interpreted as belonging with the downthrow block and is to be associated with the slate rather than with the limestone. It is likely that there was a strong horizontal component in the thrust that carried the older beds over the slates to the west of this strip.

The conglomerate along the eastern margin would appear to occupy a normal position, but the fact that it is brecciated is noteworthy. The presence of ledges yielding Lingulepis pinniformis, as described above (see page 49), along the eastern margin in the near neighborhood of the Trenton, seems best explained as an instance of faulting. The Potsdam beds seem clearly to have been overlain by younger strata, as is now the case at Stoneco quarry. It does not seem possible from the relationships exhibited elsewhere that the overlying strata were eroded so as to expose the Potsdam before the deposition of the Trenton.

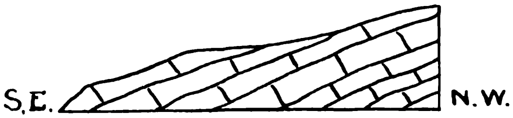

Fig. 20 Section at Danskammer

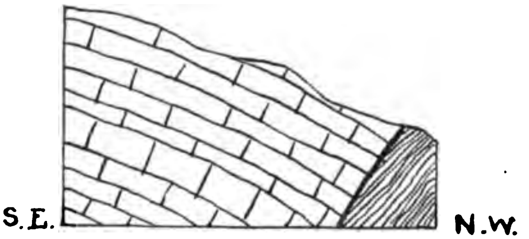

Fig. 21 Section below Marlboro station

Apparently the limestone on the west of the Hudson is essentially the continuation of this western strip, but presumably the beds are younger even than those of the quarry at Stoneco. Some of them resemble the beds of the central strip, as shown at the New Hamburg tunnel. On the west of the Hudson, near the river's edge at Danskammer, the limestone dips to the southeast at an angle of 10°. Along the western margin, as shown just below Marlboro station, the dip is to the northwest. The limestones rest by overthrust on the slates at the west.

Metamorphism and alteration. Brecciation has been noted along both margins of the strip. Fracturing has been extensive, producing many small cracks that have been healed by calcite. The broken surfaces of the rock along the eastern margin of the strip show by the smooth, distorted blackened depressions that there has been some movement in the rock. The alteration is least where the beds are flattest. The principal changes then are due to granulation which usually has been sufficient to conceal or destroy organic remains.

Summary. Presumably the Upper Cambric beds are followed in this strip by the Beekmantown (Calciferous), as is the case in the central strip; but fossils belonging to this horizon have not yet been discovered. This terrane may be represented by all or part of the dolomitic strata shown in the Stoneco quarry and their apparent equivalents to the north.[1]

Locally about Saratoga a very fossiliferous limestone lens appears in the basal portion of the dolomite formation.[2]

The trilobites discovered by Professor Dwight on the Spackenkill road, as mentioned on page 49, were like those discovered by Mr Walcott at Saratoga.[3]

No fossils have been reported from the limestone on the western bank of the Hudson within this quadrangle. In 1879 R. P. Whitfield[4] reported Maclurea magna from these limestones at Newburgh and in 1880 W. B. Dwight[5] found an assemblage of Trenton fossils in that city.

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[1] The description of the cherty, dolomitic limestone at the Stoneco quarry and overlying the Potsdam beds along the Spackenkill road was written in October 1909. At the meeting of the Geological Society at Cambridge, Mass., the following December, Professors Ulrich and Cushing described a dolomite in the Mohawk valley which "is found to consist of two distinct formations, the lower a dolomite formation of Ozarkic age, the upper a limestone of Lower Beekmantown age with a distinct unconformity between the two." The Beekmantown was described as thinning to the west, so that west of Little Falls the Lowville rests on the Ozarkic. The unconformity may be followed into the Champlain valley, reappears in the St Lawrence region "and is believed to mark the line of division between the two formations everywhere in northern New York."

[2] Preliminary list of papers. G. S. A., 22d winter meeting at Boston-Cambridge, December 1909.

[3] See Thirty-second Ann. Rept. N. Y. State Mus.; also U. S. G. S. Bul. 30, p. 21, and Science, 1884, 3:136-37.

[4] Amer. Jour. Sci., Ser. 3, 18:227.

[5] Amer. Jour. Sci., Ser. 3, 19:50-54.

THE CENTRAL STRIP

Boundaries. This strip enters the quadrangle from the north at Pleasant Valley. Its eastern margin forms the western bank of Wappinger creek north of the covered bridge at Pleasant Valley and southward follows the creek closely as far as Rochdale. At this place the limestone is in contact with the slate at the dam and on the island just below it. South of Rochdale the limestone follows the creek for one-half mile and then bears slightly to the west. It apparently ends just north of the terrace one-fourth of a mile east of Tompkins's house (see plate 17) on the Pleasant Valley road. This terrace fringes an old meander of the creek and extends around to the south side where the limestone appears again just south of the road that skirts its edge. East of the portion of this road running north and south, just west of Frank De Garmo's house, are numerous outcrops of the slates, but these disappear at the terrace slope and no outcrops appear in the deep westward embayment formed by the old meander.

This embayment is regarded as lying in a zone of transverse faulting. It seems probable that the slates were dropped down in here. At any rate, either on this account or because of faulting, a weakness was produced which the base-leveling forces caught and finally left as a gap in the ridge of limestone. It seems probable from the dimensions of certain faulted limestone blocks a short distance to the eastward that they belong in or near this gap. The slate has been dropped between the faulted masses and the dismembered main strip.

South of the break in the central strip its eastern margin follows the road until the latter turns eastward and then extends as a conspicuous wooded scarp in a north and south line to a point about one-third of a mile south of Frank De Garmo's house. At this point the limestone sends a sharp angular spur eastward for about 200 yards, as shown on the map. The strike of the slates just west of De Garmo's house, projected southward, would bring them sharply against the limestone in the included angle of this spur, showing a transverse fault between the slates and the spur and indicating that the eastern marginal scarp south of De Garmo's is a faulted one.

Limestone outcrops at the apex of this spur, whence it may be traced by continuous outcrop along the margin of the slate to and across the railroad track and highway west of Manchester Bridge. South of here the eastern margin follows the eastern base of an immense drumlin and south of this distinctly to the Poughkeepsie-

New Hackensack road; then across this and for a short distance to the south. The margin is then apparently broken by a spur in a manner similar to that just described, although this time the break appears to be along an extensive fault line. The slates which outcrop south of the Poughkeepsie-New Hackensack road and west of the cross road that leads from it to the Spackenkill road, lie in the included angle of this spur.

The contact is then easily followed southward by the steep marginal scarp in the limestone, from the point where the cross road just mentioned makes its turn, to and across the Spackenkill road, and east of the old Boardman farm. The gully which, as shown on the map, cuts across this central strip west of the northern termination of the narrow faulted strip lying on the east, may represent a fault.

South of the Spackenkill road slates outcrop in numerous places between the main strip and the narrow faulted mass just east and south through the swamp to the southern end of the small strip, leaving no doubt but that, at the surface, the two limestone masses are separated by a narrow band of the slates. The eastern contact is then very readily followed through the fields to Channingville and then less distinctly under the drift between the creek and the New Hamburg road to the bank of Wappinger creek near its junction with the Hudson.

The western margin of the central strip could be determined with much more exactness in certain places than in others. At the north the surface deposits conceal it for the most part, but swamps and other topographical features and occasional outcrops enable one to follow it approximately, and in a few places distinctly, until it crosses the Pleasant Valley road just west of Rochdale. The limestone then forms a distinct scarp east of the road to the break just southeast of Tompkins's house. South of this the margin is distinct to the railroad, but across this it is soon lost under the drift composing the large drumlin at this point. The limestone reappears on the south side of this hill and again a little farther south as a scarp which crosses the Poughkeepsie-New Hackensack road. South of this road the margin is readily followed, often with the limestone and slate in close proximity, to the Poughkeepsie-Wappinger Falls road which, going south, ascends the western scarp of the limestone. South along the New Hamburg road the contact is clearly for a distance on the east side of the road as the slate was noted in the latter. But along here the kame deposits effectually conceal the exact relationships between the limestone and slate. At the northern end of the New Hamburg tunnel the limestone rests by overthrust upon the slate (see plate 9) and occasionally the limestone outcrops along the slope to the northeast for a short distance.

Terranes present. The Potsdam, Beekmantown (Calciferous-Rochdale group) and Trenton horizons have been identified along this central strip within the quadrangle.

The Potsdam. This horizon was first noted in this strip just a little north of the quadrangle boundary half way between Pleasant Valley and Salt Point.[1] At Pleasant Valley Lingulepis pinniformis was reported along or near the western margin of the strip to the northwest of the village in rather characteristic argillaceous limestone, and also from some hills to the north of the village between the old Poughkeepsie and Eastern Railroad bed and Wappinger creek.[2] At the latter place the beds carrying L. pinniformis also had small brachiopods, apparently Orthis and Triplecia, as well as minute gastropods, fragments of trilobites and Ophileta compacta. These beds were mixed with Calciferous and Trenton strata carrying other fossils characteristic of these limestones in this region. The Potsdam was identified near Rochdale, just west of the Poughkeepsie-Pleasant Valley road. The beds exposed in the quarry just northwest of Alson De Garmo's house, from which stone was removed for the State road, are possibly of Upper Cambric age. A search for fossils in this quarry was unrewarded. In a note to his paper on the discovery of Potsdam fossils in Poughkeepsie, south of the driving park, as described for the western strip, Professor Dwight[3] mentioned the discovery of a fragment of brachiopod shell which he believed to be that of Lingulepis pinniformis in a rock very similar to that at the locality south of the driving park. He described this new locality as about one-half of a mile south of the Boardman mansion on the Spackenkill road, but it is uncertain from his description at just what point the fossil was found.

The Beekmantown (Calciferous-Rochdale group). In January 1880, Professor Dwight[4] reported the discovery of a rich assemblage of fossils of Pretrenton age at Rochdale, a small factory hamlet four miles northeast of Poughkeepsie.

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[1] W. B. Dwight. Amer. Jour. Sci., July, 1881, 34:27-32.

[2] (W. B. Dwight) J. M. Clarke. Guide to the Fossiliferous Rocks of New York State. N. Y. State Mus. Handbook 15, p. 9-10.

[3] Amer. Jour. Sci., Feb. 1886, 31:136.

[4] Amer. Jour. Sci., January, 1880, 19:50 et seq.

The following named fossils were enumerated as the most important:

"Ophileta complanata (possibly Ophileta compacta), O. levata, O. sordida (Maclurea sordida), Orthoceras primigenium." Other univalves were noted but not identified. A network of "fucoidal fronds" might be Bythotrephis antiquata. The fossils of the neighboring Trenton at the east were absent from this rock and it was believed to lie beneath the Trenton, both strata having an eastward dip. It was called the Calciferous.[1]

In October 1880, Dwight[2] found at the Rochdale locality another remarkable assemblage: "great numbers of Orthocerata and other fossils, many of which are not reported as occurring in New York State." In lithology this rock was identical with that previously assigned to the Calciferous. Orthocerata were abundant and discoidal gastropods very plentiful. In addition to its own peculiar fossils, it contained the "fucoids" and other types of the adjacent Calciferous. Dwight hesitated to announce the exact stratigraphical position of this new fossil assemblage. The wealth of cephalopods separated it very sharply from any other known terrane in the United States below the Black River-Trenton, to which it was inferior. In its numerous orthoceratite cephalopods it resembled the Quebec group of Canada.

In 1882 Diwght[3] reported tracing the Calciferous in this strip to a point five miles below Poughkeepsie. In addition to the abovenamed "Calciferous" fossils he announced in this paper: A large Holopea and smaller ones not identified, many Pleurotomaria resembling Canadian forms, a minute Ophileta n. sp., a Murchisonia resembling gracilis of the Trenton, one or two orthides, many undeterminable fragments of Bathyurus, Chaetetes lycoperdon var. ramosa, not hitherto reported below the Trenton, 25 to 30 species of Orthocerata, all apparently new in the United States, two species of Lituites and a Cyrtoceras. In 1884[4] a number of these fossils were described with figures; trilobite fragments were provisionally assigned to the genus Bathyurus (B.

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[1] The ledges at the summit of the hill north of Alson DeGarmo's house on the Pleasant Valley road belong, in part at least, to Dwight's Calciferous locality.

[2] Amer. Jour. Sti., Ser. 3, 21:78.

[3] Proc. Amer. Assoc. Adv. Sci. (Montreal meeting), v. 31. Abstract Aug. 1882, p. 3-6.

[4] Amer. Jour. Sci., Ser. 3, April, 1884, 27:249-59.

taurifrons and B. crotalifrons). New cephalopod species were described as Cyrtoceras vassarina, C. ? dactyloides, C. microscopicum, Orthoceras apissiseptum; O. henrietta, Oncoceras vassiforme.

In 1900 Dwight[1] designated the main Calciferous strata as the Cyrtoceras vassarina beds and called attention to the great persistence for a distance of nearly thirty miles in the Wappinger limestone, of a layer which contains a fauna quite different from that of the main beds. It lacked cephalopods entirely. There were no important fossils in common in the two beds except two or three always present in the Calciferous. In some respects it resembled the Fort Cassin of Vermont, but differed in the extreme scarcity of cephalopods. The presence of Lingulepis pinniformis suggested a low horizon in the Calciferous. What Dwight has called a low horizon in the Calciferous may be Upper Cambric disconformably overlain by Beekmantown.

The Trenton. Fossils belonging to this horizon were the first to be discovered in the Dutchess county limestone and were first reported from the area within this quadrangle.

Mather referred only in a footnote to their having been found in a quarry south of Pleasant Valley by Professor Briggs. His assignment of the age of this formation was based on fossils found in the beds of limestone within the slate formation a mile or so north of Barnegate.

In 1879 Professor Dwight[2] found the following Trenton fossils at Rochdale: Leptaena (Plectambonites) sericea, Orthis tricenaria, Receptaculites sp. A week after the discovery Dwight and Dana visited this locality. The following fossils were found: L. (P) sericea, Escharapora recta, Ptilodictya acuta, the caudal shield of a trilobite probably Asaphus vetustus, Orthis tricenaria, O. pectinella, O. testudinaria, an Endoceras, an Orthoceras, specimens of Chaetetes, and encrinal columns.[3] On this same excursion the quarry south of Pleasant Valley, mentioned by Mather, was visited. A fossil assemblage very like that at Rochdale was at once discovered. Subsequent examination of this collection showed Strophomena alternata fragments. The Chaetetes was named by Dwight C. tenuissima.

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[1] Bul. Geol. Soc. Amer., v. 12, 1900, abstract.

[2] Amer. Jour. Sci., May, 1879, 17:389.

[3] Amer. Jour. Sci., May, 1879, 17:390. See also p. 381.

In 1880 Professor Dwight[1] added to the above from the Rochdale locality: a number of cyathophylloid corals, among them Petraia corniculum, a head of Echinoencrinites anatiformis, and the caudal shield of a trilobite identified as Illaenus crassicauda. The C. tenuissima was identified as in part at least, Stromatopora compacta Billings (Chaetetes compacta Dawson). This fossil is now recognized as Solenopora compacta.

The Trenton also occurs at Pleasant Valley in the railroad cut just east of the Central New England station on the old Poughkeepsie and Eastern road. The Trenton beds here have yielded Tetradium cellulosum and great numbers of entomostraca and fragments of small trilobites.[2] The characteristic Trenton conglomerate carrying Solenopora compacta occurs at the northeast end of the cut. The Trenton apparently has an extension eastward in the village. The conglomerate carrying fossils was noted by the writer at the hose house.

It is quite probable that other Trenton localities in later years were noted by Professor Dwight which were never published.

Petrography and further description. Beds from this strip, which have been referred to the Potsdam, vary from argillaceous to arenaceous limestones with occasional shaly layers. It is not possible to say much about the extent of the Potsdam along this strip to the south. It may occur at many places for which, however, there is at present no paleontologic evidence. The structural features suggest that it is probably confined to the northern and central portions of the strip and that the beds at the south are probably younger The shaly limestones in the quarry west of the tunnel at New Hamburg have been thought to be of Potsdam age on stratigraphic grounds.

The Beekmantown (Calciferous) of this strip is best studied at its type locality at Rochdale. It is often, if not characteristically, arenaceous and varies in color from a bluish gray to a gray with lighter chamois-colored layers which weather very white. The two are interstratified, though the writer's observations indicate that the bluish beds are usually near the eastern margin and therefore in the upper layers. The bluish beds carry grayish wavy markings and are very tough and splintery, breaking with conchoidal fracture.

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[1] Amer. Jour. Sci., v. 19, January 1880.

[2] (W B. Dwight) J. M. Clarke. Guide to the Fossiliferous Rocks of New York State. N. Y. State Museum Handbook 15.

The lower portion of the Calciferous shows many thick, grayish layers in places.

Apparently the Beekmantown has a wide distribution in this strip. It forms the main mass of the high hill northwest of the Trenton in the cut at Pleasant Valley and may be traced rather satisfactorily as a lithic unit to Rochdale, where it is seen to have a great thickness, estimated at from 1000 to 1200 feet. Dwight claimed to have traced it definitely to a point five miles below Poughkeepsie (see above). The beds resting on the slates at the New Hamburg tunnel are probably of Beekmantown age.

At Rochdale the Beekmantown in places passes through a heavy conglomerate into the Trenton which rests upon it. Just a little way south of a ledge of this conglomerate on the property of Henry Titus, along the road, are fine exposures of the bluish-gray beds. These give place at the west to the gray and dove-colored beds which compose most of the hill between Rochdale and the Pleasant Valley turnpike.

The bluish-gray beds were noted farther south near the eastern margin just north of the break in this strip. Taking the apparent thickness at Rochdale as a guide, the beds intervening between these blue beds and the scarp just east of Tompkins's house are probably all Beekmantown. South of here the lithology does not convey very much, though indicating on the whole the southward continuation of the lower portion of the Beekmantown as shown at Rochdale.

Within this strip farther south, about one-fourth mile north of the Spackenkill road, along an old wood road, or cow path, are probable beds of the Beekmantown within a few rods of coarse Trenton conglomerate apparently carrying Solenopora compacta. The road from the orchard on the north side of the Spackenkill road, opposite the old Boardman farm, leads to these outcrops. This locality is seemingly not so far south as Professor Dwight claimed to have traced the Beekmantown; but the writer has not been able to add anything definite to the age of this belt to the south of this point.

The Trenton, within this strip, is usually a dark blue rather crystalline rock of quite different appearance from the Beekmantown. Its lower portion is conglomeratic and carries colonies of the coral S. compacta which, without careful examination, might be taken for pebbles. This coral, or a conglomerate appearance, is often the only means for identifying this member of the limestone formation. The Trenton is also somewhat finely conglomeratic at times. The conglomerate was noted at Pleasant

Valley, at Rochdale and north of the Spackenkill road. The Trenton also is probably present in places not yet discovered along the eastern margin of this strip. At Rochdale the dark blue Trenton beds have a thickness apparently between 60 and 100 feet and form a conspicuous stratum.

Strikes and dips within this strip show much uniformity. In the Poughkeepsie and Eastern Railroad cut at Pleasant Valley the Trenton beds show a strike about n. 37° e. and a southeast dip. In the quarry on the Pleasant Valley road to the west of Rochdale the supposedly Potsdam beds strike n. 42° e. and dip 60° to the southeast; at Rochdale in the road near the mill site, the strike is n. 40° e. and the dip 55° southeast; at the conglomerate ledge on the Titus place approximately n. 43° e. and 58° s.e.; at the eastern margin east of Tompkins's n. 28° e. and 35° southeast; north of the Spackenkill road in the woods near the old barn n. 53° e. and 42° s.e.; at the New Hamburg tunnel about n. 60° e. and 30° s.e.

Structural features. The presence of an erosion interval between the Trenton beds and the Beekmantown is conclusively shown by the relationships at Rochdale. The Beekmantown is separated from the Trenton by a heavy conglomeratic layer, and the fauna and lithologic character of the two strata are markedly different. The general uniformity of dip shows a "deceptive unconformity" or "disconformity."[1] From the apparent thickness of the Beekmantown at Rochdale, it would seem that this formation was not extensively eroded here.

The limestones of this central strip rest against the slates on the west by overthrust. This is best shown at the north end of the New Hamburg tunnel (see plate 9). The occurrences of the Potsdam along this western margin is also evidence of it. Frequent slips along and across the strike within the limestone are probably present.

The slates along the eastern margin of the strip may be at places in conformable relationship with the limestone. In other cases such is almost certainly not the case.

Metamorphism and alteration. The strata composing this strip are all visibly altered. Fossils have usually been greatly obscured. The Beekmantown shows the metamorphism most. Fossils in it are recognized or identified usually with difficulty although they sometimes weather out with distinctness. The Trenton beds are usually somewhat crystalline, but fossils are preserved in them in better condition than in the Beekmantown.

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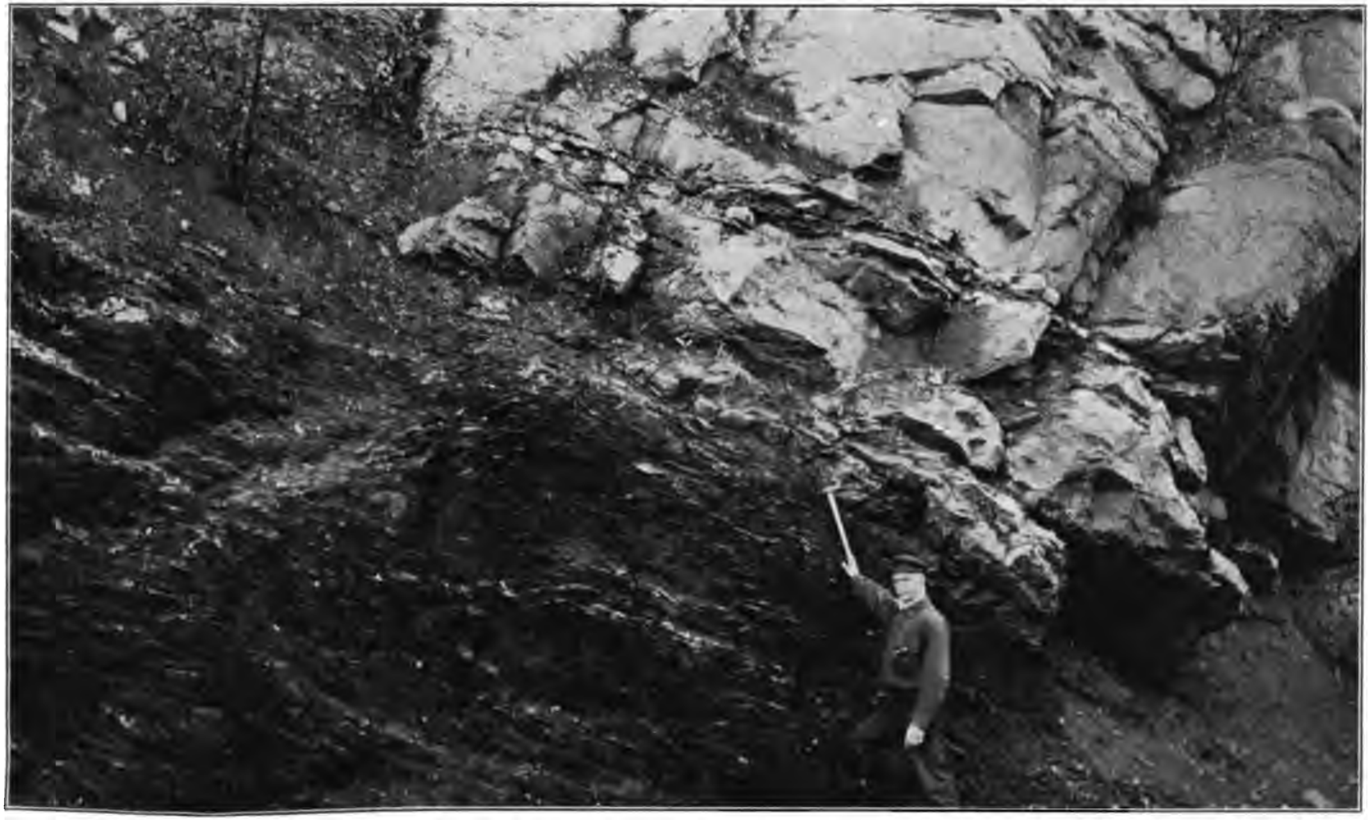
[1] Professor A. W. Grabau. Science, n. s., 22:534.

Plate 9



Limestones overthrust on the slates at the northern end of the New Hamburg tunnel

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Summary and conclusion. The absence of the Trenton conglomerate at places along the eastern margin of the central strip might be interpreted as the result of faulting and, in any event, is probably due in part, at least, to faulting.

The presence of Tetradium cellulosum in the Poughkeepsie and Eastern Railroad cut at Pleasant Valley is noteworthy. Professor Clarke[1] has indicated that elsewhere this fossil is characteristic of the Lowville. The Trenton conglomerate at this locality is apparently a few feet above the beds carrying this fossil. This would seem to indicate that the Lowville might have been deposited here. Doctor Ruedemann[2] has discussed the Trenton, as descrbed by Dwight, as probably not lower than Midtrenton in age.

The examination of this strip leaves one in great doubt as to how to represent its structure. It is certainly very different from Professor Dana's early representation as a simple fold.[3] It is best interpreted as belonging to the same thrust that pushed the western strip on the slates, but as the map shows the limestone broke both along and across the strike and at the south was pushed farther west, apparently feeling the influence of the Highlands mass.

MISCELLANEOUS FAULTED BLOCKS OF THE WAPPINGER CREEK BELT

Several smaller limestone masses, each of which can be reasonably shown to be a detached and separate block, forming an inlier in the slates, are scattered to the east of the central strip along its middle portion. The mantle of the surface deposits at times greatly obscures their exact relationships to the slates, but as a rule the field relations leave scarcely any doubt of their inlying character. In most, if not all cases, these relations point to faulting, both along and across the strike between the limestone masses and the slates which surround them.

These blocks will be described separately and will be designated by numbers from north to south. The occurrence of these faulted blocks of limestone to the east of the central strip seems to be directly due to the thrust which carried the limestone of this belt over the slates. They have been left, stranded as it were, behind the main mass.

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[1] Guide to the Fossiliferous Rocks of New York State. N. Y. State Mus. Handbook 15, p. 9.

[2] Hudson River Beds near Albany and their Taxonomic Equivalents. N. Y. State Mus. Bul. 42, 1901, p. 501.

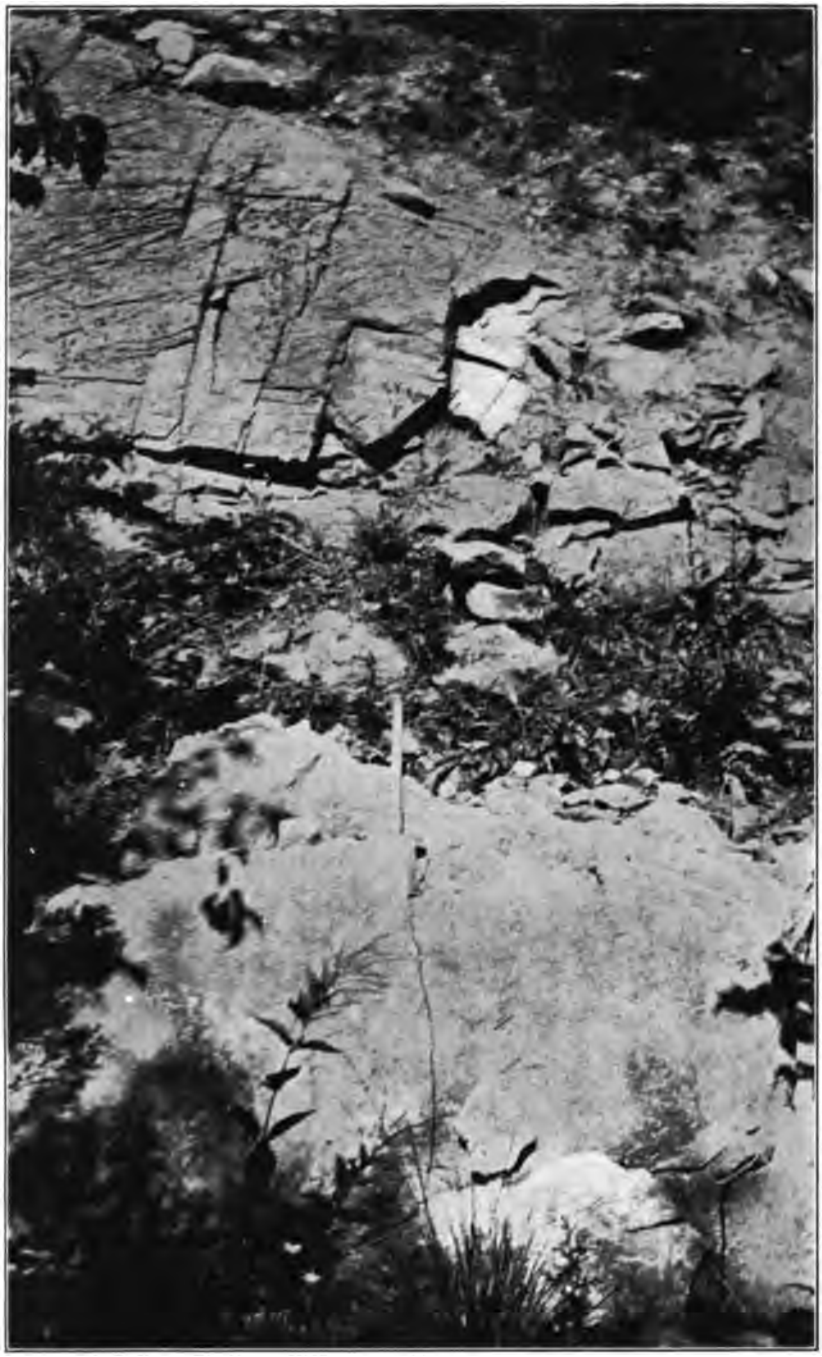
[3] Amer. Jour. Sci., May, 1879. 17:382.

Faulted block number 1. This block of limestone, which is the most northerly of these masses, lies about a mile north of Manchester Bridge on the farms of A. W. Sleight and George Byer. Its apparent northern boundary is along a northwest-southeast line that crosses the Sleight farm just north of the barn and intersects the roads to Pleasant Valley and to Overlook. About 75 yards south of the Overlook road, where this makes its first turn in ascending the hill, the visible northeastern boundary of the limestone is marked by a ledge. Its eastern boundary extends south from here for about one-fourth of a mile. At the southeast the limestone is represented by impure shaly limestone. At a point just north of the wall between the Byer farm and Hart's orchard, the slate outcrops and continues to outcrop to the south for a mile or more. The slates are in close proximity to the limestone in many places along the eastern border. Just south of the sheep pen they form a scarp between which and the limestone the farm road descends. The road is, however, apparently on the limestone. The limestone outcrops just south of the farm road at the base of the hill and continues as a steep scarp just within the woods northward from this point for several hundred yards and then turns west and crosses the road and ends in a large ledge 50 feet west of the road. North from here it is finally lost under drift, but is readily followed along the road toward Sleight's house. There are no outcrops of any kind between Byer's house and barns, which stand on a knoll of limestone, and the steep scarp 200 yards east of the road. Ledges of limestone probably determined the terrace slope just west of Sleight's house. Drift conceals outcrops north of Sleight's barns. Quartzitic rock of the slate formation outcrops between the Pleasant Valley and Overlook roads 100 feet north of the latter. Between here and the outcrop of limestone marking the northeast corner of the block there are no outcrops. Presumably the limestone, in part at least, underlies the flat terrace level just east of Byer's house.

On the eastern margin of this block, partly on the property of A. W. Sleight and partly on that of George Byer, is an old quarry, which many years ago furnished stone for the abutments of the bridge at Manchester. The fact that this is a rich fossil locality appears up to this time to have escaped attention.

There are two varieties of rock in the quarry. The one which was quarried chiefly and which makes up most of the quarry is a dark blue rock which varies in texture from a fine calcareous con-

Plate 10



A portion of the wall in A. W. Sleight's quarry. In the foreground Trenton conglomerate with Solenopora compacta resting on probable "Calciferous" which is exposed in the upper half of the picture. The two are disconformable, but have the same dip to the southeast

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glomerate, shown at the south end and in the central part of the quarry, to a dense fine-grained mud rock at the northern part. The bedding surfaces are distinct, and good-sized blocks, frequently a foot or more in thickness, have been removed. The rock has been weakened by blasting. It still breaks with difficulty into thin irregular pieces that are often crowded with fossils and their fragments. The removal of the mud rock at the south end of the quarry has exposed the basal conglomeratic portion which contains abundant crinoid stems, colonies of Solenopora compacta and some brachiopods. The quarry faces east. The beds of limestone strike n. 40° e. and dip 42° s.e. At the top of the quarry, under the bank and at the summit of the ridge the rock changes to a chamois or gray color but retains the same strike and dip.

About seven or eight feet in thickness have been preserved of the finer-textured blue mud rock at the north end of the quarry. Fossils are distributed through it, but could be removed in numbers only from the surface layers. The rock has yielded:

Orthis pectinella	31
Plectambonites sericeus	18
Dalmanella testudinaria	13
Strophomena alternata	1
Orthis lynx	3
Streptelasma sp. (resembling parvula)	2
Chaetetes lycoperdon	3
Ceraurus pleurexanthemus (probably)	3
Platynotus trentonensis (probably)	1
Calymmene senaria	6
Phacops sp. (probably)	1
Illaenus crassicauda (probably)	1
Ostracod (undetermined)	1

At the western base of the ridge, somewhat to the southwest of this quarry, and now completely hidden by thick underbrush within the edge of the woods, is another and older quarry from which it appears the rock was removed and burned for lime a good many years ago. Solenopora compacta was noted here.

The width of the dark blue limestone stratum on the east is probably less than a score of feet. A small diagonal fault crosses the limestone just west of the road that ascends to the sheep pens.

The blue rock of the quarry is the same as that at Pleasant Valley and Rochdale. The chamois-colored or gray rock is assumed to be the Beekmantown (as qualified above).

The presence of the Trenton along the western scarp, as marked by S. compacta, accompanied as it is by a scarp, suggests that it probably is faulted in here.

Faulted block number 2. Whether this block is distinct from number 1 might be a matter of interpretation. The house and barns of George Byer are built on the summit of the western scarp of this block which, west of the house, descends abruptly to the level of the present flood plain of the creek. The northern margin ends 100 yards north of the barn. The most eastern outcrop at the north is separated from the ledge, marking the visible western margin of block number 1 by a shallow gully. The two may unite below the surface. At the south the limestone is lost under the terrace, but it is assumed to continue south for a distance. The slates do not outcrop between its western scarp and Wappinger creek, but as the slates extend well up in this space in the bed of Wappinger creek and west of it they almost certainly underlie the interval where outcrops are concealed. The block is regarded as a dismembered part of the central strip. The slates have been dropped down between the latter and these two blocks at the east.

Faulted block number 3. The evidence for the presence of the limestone at this point consists of two small detached ledges apparently in place, and a scarplike topography. The low hill shown on the map at this place was approached through the fields south of Manchester Bridge station. The northern slope of the hill is made up of drift, but along the wooded western slope a careful examination disclosed a small ledge of conglomeratic rock with a strike of n. 5° w. and a dip of 32° e. The base of the slope is marked by a swamp. A few hundred feet to the southeast is another ledgelike mass of the limestone with nearly the same strike. North near the railroad and east and west outside the cover of the drift and in the fields at the south are low-lying ledges of slate.

Faulted block number 4. The visible northern termination of this block is on the farm of Mr Rothenburg at Titusville. The limestone forms a conspicuous ledge just southeast of the barn. Its eastern margin may be followed southward as a low scarp across the road where the limestone abruptly disappears under the lowland along Wappinger creek. In places along the eastern margin, and well shown in two ledges just southeast of Rothenburg's house, the apparent dip is about 55° w. and the strike about n. 44° e. and the rock appears somewhat thin-bedded. The western margin is indistinct. The limestone outcrops just under the road bank, where the road turns east, and rests against the slates in the bed of the brook.

On the north side of the road near the turn is an old quarry. No fossils were found, but the quarry rock resembles the dark blue mud rock of the Trenton.

Faulted block number 5. Between this block and number 4 is an interval of lowland forming the present flood plain of Wappinger creek. This interval is probably underlain by the slate which was dropped down in here and which, in connection with faulting, produced a line of weakness which the base-leveling forces early reduced and which has been perpetuated by the present stream. Outcrops are concealed in the flood plain interval except near the southwest corner of block number 4. At this point there is a large patch of slate that has been planed down and which disappears under the alluvium at the southeast.

The rather steep slope on the southwest side of this interval is taken as representing the northern margin of block number 5. The eastern and western margins are approximately those shown on the map, while the southern margin appears to be along the great fault line at this point. Surface deposits conceal the northern margin, but outcrops are occasional to the north of the Poughkeepsie-New Hackensack road, and almost continuous along it from east to west. The western margin is easily followed along the crossroad to the Spackenkill road until the limestone is cut off by the fault. No fossils were found in this patch of limestone and the lithology did not help in making any provisional correlation with other localities.

Faulted block number 6. This small strip lies south of the Spackenkill road and is a little over a mile long and less than one-fourth of a mile wide. It is separated from the main central strip by a narrow band of the slates which form conspicuous ledges for a few hundred yards south of the Spackenkill road and are traceable along the edge of the swamp through the woods to the southern termination. At the south the limestone disappears abruptly beneath the slates just north of the old barn and probably is faulted here. At the north it also gives place to the slates north of the Spackenkill road and is certainly faulted here. The limestone of this strip forms a conspicuous ridge throughout its length. No fossils were found although a careful search was made, particularly near the southern extremity.

Faulted block number 7. This block lies farthest east of all. The boundaries are best indicated by the map. The entire strip has a northeast-southwest bearing which closely follows the general strike of the limestone. It is about one and one-fourth miles long and one-fourth of a mile wide. At the north it disappears beneath the low ground along the railroad and gives way at the north to slates, although some distance intervenes between outcrops. The northern margin is plainly a faulted one and lies along the very prominent but narrow valley that forms the route of the Central New England Railroad track almost the entire distance from Hopewell Junction to Manchester Bridge. That this represents a line of faulting is reasonably certain. As a topographic feature it may be followed across country for miles. It is often swampy, frequently for long distances, and this feature was probably still more prominent before the railroad bed was put in. It does not have the appearance of having been a prominent line of drainage, but rather a more extensive illustration of the topographic effect of base-leveling forces operating along a continuous line of weakness such as a great fault would produce. There are other conspicuous illustrations of the same kind, both within the slates and limestones of this quadrangle.

The southern margin is obscured by a great mass of drift, but the limestone is almost certainly cut by a fault on the southwest.

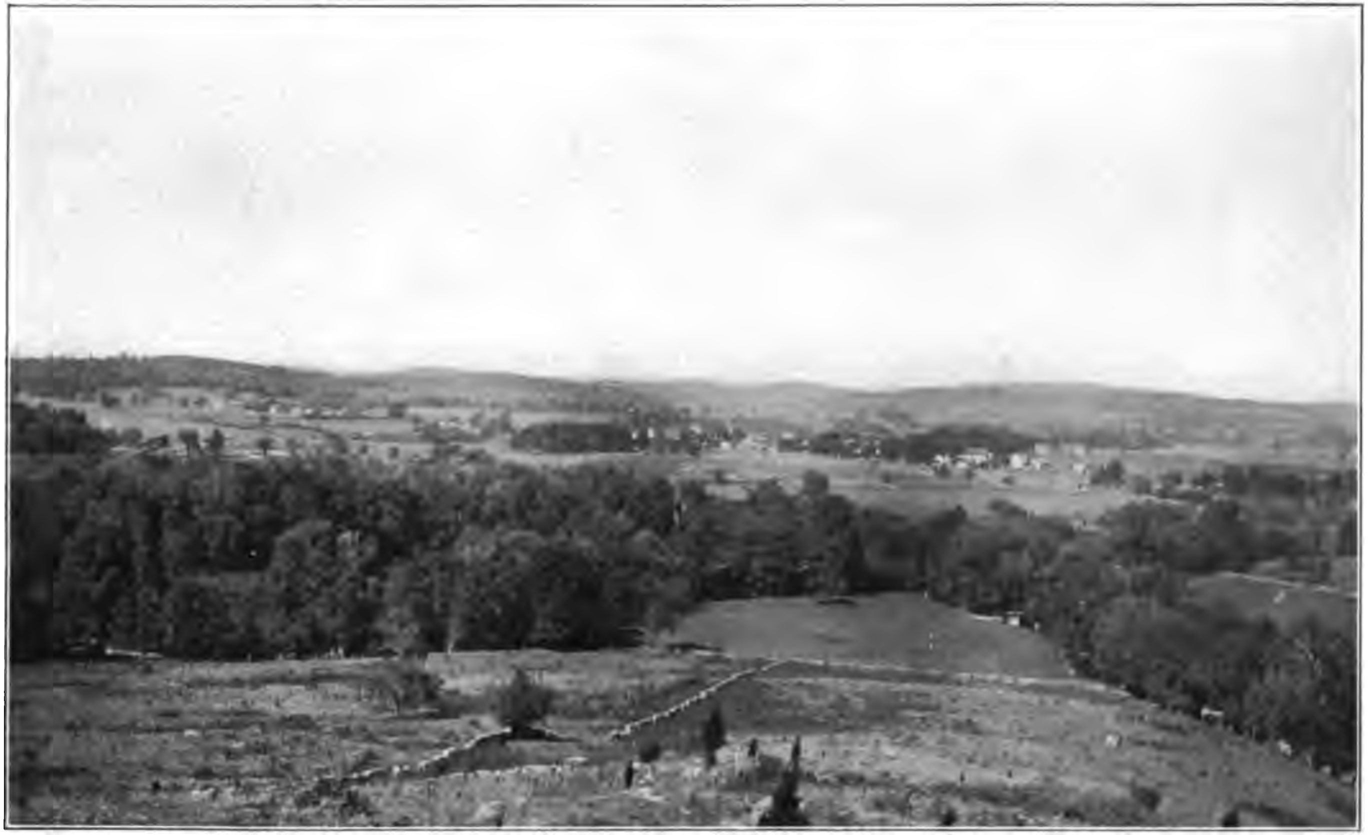
A mile and a half north of New Hackensack a crossroad connects the New Hackensack road with another running for some distance parallel with the railroad track. The northwestern margin may be followed from this road northeastward to the railroad track, outcrops appearing between the latter and the road just south of it. Along this margin the limestone shows a low scarp for some distance. The eastern margin is also easily followed as a scarp from the crossroad where the limestone appears in contact with the black, splintery slates northeastward to the railroad. Outcrops occur along the public road at the north. Everything is concealed south of the crossroad at the south.

The limestone of this block is of a very dark bluish-gray color. It often shows veinlets and nests of calcite. Fresh surfaces show darker and more crystalline bunches in a rock of dark gray color. The rock is more crystalline than other members of the Wappinger creek belt. In lithology, it often has a strong resemblance to varieties met with in the Fishkill limestone, notably southeast of Hopewell. No fossils were found. The average strike is about n. 60° e. and the dip 40° s.e. The block forms a distinct topographic feature.

THE FISHKILL LIMESTONE

The belt of which this limestone is a part may be traced with some interruptions from Millerton in the northeastern corner of Dutchess county nearly to the Hudson river. The portion within

Plate 11



A view from "Bonney hill" south of Hopewell Junction, looking northward. Near the center of the picture is the village of Hopewell Junction. North of the village is the triangular valley in the faulted Fishkill limestone (see map)

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ASTOR, LENOX AND
TILDEN FOUNDATIONS.

this quadrangle occurs as a great fault-bounded block north of the Fishkill mountains. Northeastward it may be followed up the Clove valley, east of which it passes under the mass of schist composing Chestnut ridge and reappears in the Dover-Pawling valley.

The overlying slate formation has been removed from this faulted limestone mass within this quadrangle, which makes it convenient to discuss the mass as a unit.

Boundaries. The northern boundary enters the quadrangle from the town of Beekman and extends southwestward along the old roadbed of the Clove branch of the Newburgh, Dutchess and Connecticut Railroad to a point about one mile east of old Hopewell, where it intersects a northwest-southeast fault and turns with a sharp angle to the northwest. The actual contact of limestone and slate usually can not be seen, but the field relations and obvious fault features approximately determine the course of the boundary. Somewhere south of Arthursburg, the actual point being concealed, the boundary again turns abruptly, this time to the southwest, as shown on the map, and follows the valley of the Whortlekill to a point just west of Hopewell Junction, and then turns to the northwest to follow the fault previously referred to, along the raliroad. Three-fourths of a mile west of here a ledge of shaly limestone marks the northwest limit of the limestone along this fault line. The slates extend down into the included angles of these fault lines, as shown on the map. Southwest from the ledge of shaly limestone just mentioned the boundary is easily followed across the fields, often with a clear scarp or other distinct topographic feature, and with slate and limestone frequently in close proximity, to the fault that bounds Vly mountain on the east; then north along this fault, with the slates again in the included angle, to Vly mountain, which is bounded by the limestone on the south. Southwest of Vly mountain the limestone bounds the Glenham belt to the carpet mill at Glenham. South of here it is faulted against the slates for half a mile, then rests against the gneiss of the northernmost inlier in the town of Matteawan, then on the quartzite patch just south of this, and again on the gneiss.

Its southern margin has been described sufficiently in connection with the gneisses and the quartzite.

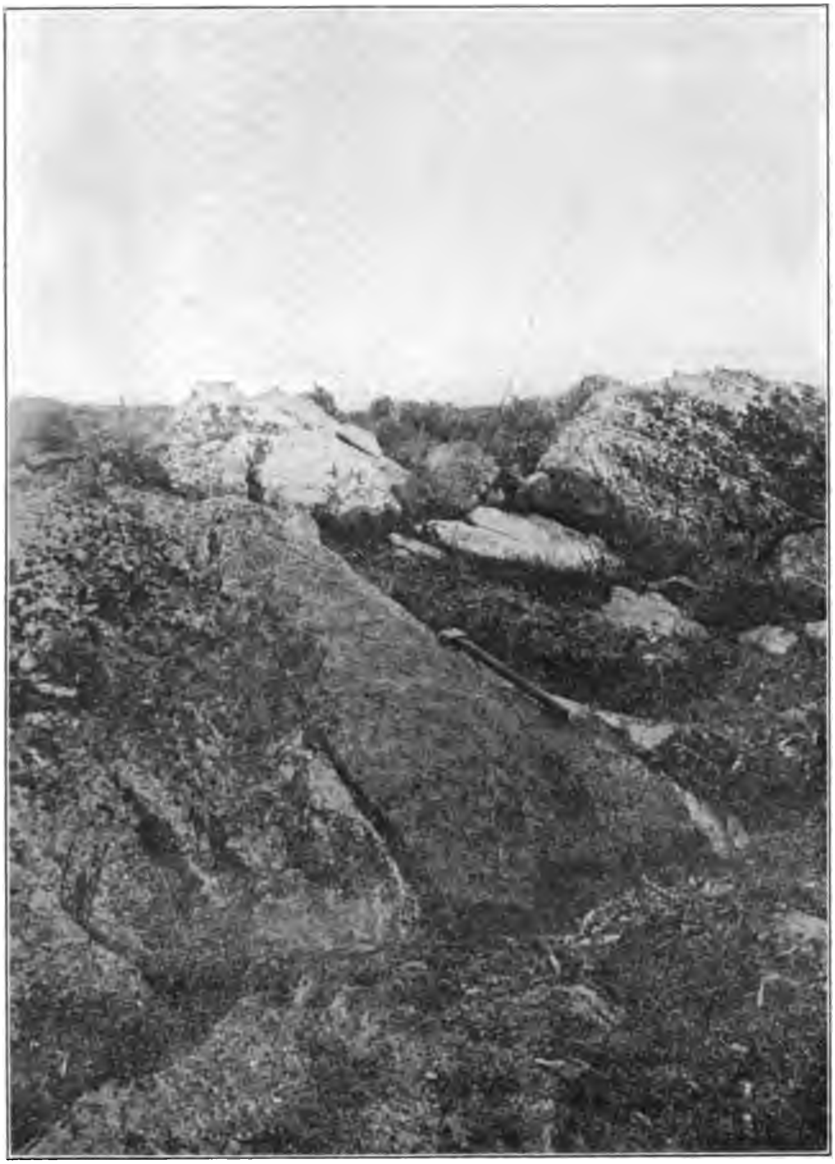
Terranes present. The fossil localities so far discovered in this limestone are limited in number and in distribution. The Lower Cambric (Georgian), Beekmantown and Trenton have been definitely identified. In the systematic and extensive examination of outcrops in cuts and weathered surfaces, suggestive markings have been noted and collected at several places. Increasing metamorphism to the eastward has destroyed or otherwise effaced traces of organic remains, besides making very difficult any provisional correlation on the basis of lithological resemblance. Folding, faulting and erosion have added great confusion.

The Lower Cambric (Georgian). Strata belonging to this horizon have been described under the heading, " The conformable series of West Fishkill Hook (see page 44). The reasons for their preservation here are not quite clear, but evidently the conditions are peculiar. As previously discussed, it seems probable that the Lower Cambric limestone is, as a rule, not in association with the quartzite of that epoch which more probably rests against younger strata at most places. The patches of limestone resting upon the quartzite at Vly mountain and in Matteawan may be of the same age. Some peculiar, very thinly-bedded metamorphosed strata, which were noted standing on end in the swampy areas east of Mount Honness, may represent the shaly member of the Lower Cambric series and these Lower Cambric rocks may have an extension to the north from here in certain rock types that will be described beyond.

The Beekmantown. Fossils belonging to this horizon were found along the western margin of the Fishkill limestone. They were first noted north of the road from Fishkill Village to Glenham on the farm of Albert Haight, in the second field west of Haight's house, about 300 or 400 yards from the public road. The rock carrying the fossils is of a light gray or steel-gray color and is interbedded with other rock which weathers to a soiled gray. The weathered surface of the former shows many spiral coils. The fresh surface reveals a much altered rock. No traces of the whorls, so plainly visible on the weathered rock, can be seen on the freshly-broken surface; but the latter is often dotted or splotched with numerous orange or pollen-yellow markings.

In this field there are two conspicuous ledges of the fossiliferous stratum besides many outcrops of other ledges, for the most part soil-covered. In the northwest corner of the next field to the north on Haight's farm is another ledge of the light gray rock covered with the coiled markings. This stratum was traced by scattered outcrops carrying the coils along and within the edge of the woods and thick brush for a mile to the northeast, to within about half a mile of the road from Fishkill Village to Glenham, and then was lost. Beyond this road it has not been noted, unless it may be

Plate 12



Fossiliferous ledges on the farm of Albert Haight, between Fishkill Village and Glenham. The surface marked by the hammer is covered with the whorls of Ophileta compacta, some of which are visible in the plate

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represented by a somewhat banded bluish rock without visible fossils which was found on the very edge of the limestone about four miles to the northeast at Swartoutville, a hamlet two and one-half miles north of Brinckerhoff. On the Haight farm the fossiliferous limestone is well exposed in the fields, but in the brush it is followed with great difficulty. This rock, or that with which it is interbedded, is overlain by a calcareous conglomerate in certain places.

The fossiliferous limestone is very dense and compact. It is quite impossible to remove the coils from the smooth surface. A hard blow with the sledge simply chips the rock into small pieces with conchoidal fracture. The chisel makes no impression.

The coils are most distinct when at right angles, or nearly so, to the axis of the whorls. They then show as fine spiral lines, resembling a fine loosely-coiled watch spring, which have weathered out very sharply into bas-reliefs. When in the plane of the axis, or at a small angle with it, the lines are thick and patchy. The fine coils vary in diameter from one and one-half inches to three-fourths of an inch. The medium-sized are most abundant. They bear the closest resemblance to the discoidal gastropod Ophileta compacta Salter, as described for the Calciferous of the Quebec group[1] (see plate 12).

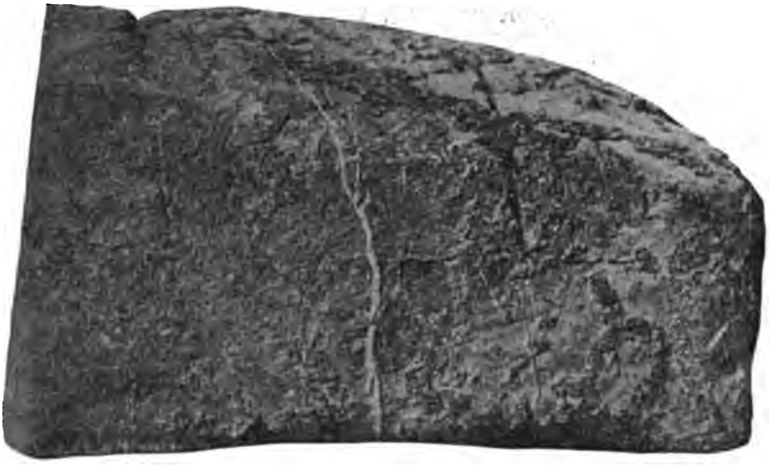

Fig. 22 Whorls of a discoidal gastropod identified as Ophileta compacta Salter, from the ledge shown in plate 12

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[1] Canadian Organic Remains, 1859. Decade 1, p. 16, plate 3.

The smaller coils resemble the Maclurea sordida and Ophileta levata of the Calciferous of New York.[1] One form, which very closely resembles the Ophileta complanata as figured by Hall[2] was noted.

The fossiliferous rock at Haight's farm lies just east of the Glenham gneiss belt with outcrops of the latter not more than 150 or 200 feet away. The strike of the limestone varies from n. 15° w. to n.-s. and the dip from 35° to 40° e. The strike is such as to carry the limestone diagonally across the gneiss belt. The distance separating the gneiss is too short to allow a very great thickness of older beds to come between the two. South of the fossiliferous ledges in the quarry used by the State road contractors on the farm of Mr Wilsey, are thick-bedded arenaceous limestones with a strike of n. 35° e. and a dip of 51° s.e. These are probably older beds.

East of the ledges of Beekmantown outcropping along the Glenham belt, this horizon has not been definitely identified. In the town of Old Hopewell, just east of Fishkill creek, is a prominent hill which has some beds strongly suggesting the blue beds interstratified with the gray ones in the main strip of the Wappinger creek belt at Rochdale and two or three miles south of that hamlet. The two rocks look very like each other and the resemblance is strengthened by the presence of the peculiar seaweed-like markings which have been described. The rock at Hopewell is more metamorphosed. Along the track of the Highland division of the New York, New Haven & Hartford Railroad, in the cut three-fourths of a mile east of the railroad bridge crossing the creek east of Hopewell Junction, these blue layers form the upper portion of a gentle, northward-pitching anticlinal fold (see plate 13). A distinct fault is seen just east of here crossing the track and, when traced northward, this is seen to be in line with the recess shown on the map just south of the point where the creek turns northward in making its detour around the hill. East of this northward bend the creek has cut a gorge in the limestone, having been deflected southward by a great mass of glacial deposits that flanks the limestone knoll north of Gregory's mill. On the weathered surface of this knoll a fossil, which looked like a cephalopod, was found.

This rock resembles the blue layer just described. It often shows a banded character which recalls the banded marbles or crystalline limestones seen in the quarry two miles southwest of Millerton.

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[1] Palaeontology of New York. 1:10-11, plate 3.

[2] *loc. cit.*, p. 11, plate 3.

Presumably the beds with which the bluish beds are interstratified belong with them and the Beekmantown may be fairly well represented. Elsewhere it has not proved possible to make any correlation even of a provisional character with this horizon.

The Trenton. The presence of this horizon within the Fishkill limestone was first indicated on the basis of fossils by Professor J. D. Dana.[1] He described the white fine-grained and gray limestones north and east of Shenandoah and announced the discovery in the gray rock " one-third of a mile north of Shenandoah Corners " of " large shells of a Strophomena like S. alternata, distinct in form though disguised by pressure and slight alteration, indicating for the beds a Trenton age." He also noted suggestive forms and markings between Hopewell and Fishkill,[2] but nothing of distinctive value was obtained.

This horizon, as known from the Wappinger belt, was definitely identified by the writer along the western margin of this limestone in close association with the beds carrying Ophileta compacta. In the second field northwest of the barn on the farm of Albert Haight, on the road from Fishkill Village to Glenham, a ledge of coarse conglomerate lies just south of the ledge showing the O. compacta. A few yards east of the latter ledge a finer conglomerate carrying Solenopora compacta was discovered. The latter is almost covered with soil and this rock is exposed in only a few places. The conglomerate was also followed along the edge of the wood in a series of low-lying knolls for some distance. About half a mile northeast of these ledges, about 350 yards northeast of the Southard house, and the same distance north of the public road, near the edge of the woods, at the point where an old wood road leaves the woods, the light grayish-colored rock passes into a thin layer of fine conglomerate of the same color and then abruptly into a dark blue fine-grained conglomerate. The ledge showing this transition is in place, but is very narrow and lies nearly flat, dipping at a very slight angle to the southeast. A hundred feet northeast of this ledge, beyond a stone wall, the coarse conglomerate outcrops. What appeared to be brecciated conglomerate was noted in one or two ledges farther north.

There is thus a narrow, but well defined, strip of the Trenton conglomerate along the western margin of this limestone. Its former eastward extension is wholly problematical.

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[1] Amer. Jour. Sci. Ser. 3. Dec. 1880. 20:452.

[2] Amer. Jour. Sci. Ser. 3. May, 1879. 17:383.

At Swartoutville, a little hamlet about half way between Brinckerhoff and Hopewell Junction, on the farm of Irving Hitchcock, a calcareous conglomerate, with the pebbles squeezed into bands, outcrops in places between the bluish-gray limestone, referred to above as possibly representing the Beekmantown, and the calcareous shales with interbedded limestone layers, the latter lying on the west along the margin of the limestone. In other places the shales with their interbedded limestones grade downward into a fine conglomerate with what looked like S. compacta and other fossils.

During the spring of 1909 a number of new cuts were made in the limestones along the road from Johnsville to Stormville in the process of constructing the State road. In one of these, about two miles east of Johnsville, a fairly distinct impression was found. This may be a fossil. The general form is apparently preserved, but the details are obliterated. Other blackened and much more distorted impressions were noted. These impressions, together with other markings, such as bunches of calcite crystals, mark the rock as probably fossiliferous.

Some peculiar lithic variations within the Fishkill limestone. Northeast of Johnsville, on the farms of Messrs Gildersleeve and Taylor, are frequent outcrops of a coarse silicious limestone, which was not noted elsewhere in this limestone belt. It somewhat resembles the basal quartzite at times. It is always calcareous, effervescing readily with cold dilute acid, but leaving a prominent residue of quartz. It is interbedded with other limestones, which in their lithological characters recall the chamois-colored beds in the Beekmantown of the Wappinger creek belt. The silicious rock just referred to outcrops along the road south of Bonney hill north of Taylor's house, while Bonney hill seems to be largely made up of the medium-bedded chamois-colored rock, except at the west along the lower portion of the scarp slope, where it gives place to a gray limestone. No fossils were discovered in these limestones. It is noteworthy that they lie close to the northward continuation of the strike of the rocks in the West Fishkill Hook district.

A diligent search was made within this limestone east of the western margin for a conglomeratic layer, but none was found. What appear to be coarse brecciated zones are of frequent occurrence, particularly west of the Honness spur. These were noted just southeast of Milton C. Hustis's house at Brinckerhoff, between Mount Honness and Fishkill creek, where the rock is mashed, and in the Newburgh, Dutchess & Connecticut Railroad cuts between Fishkill Village and Brinckerhoff, and less noticeably but plainly elsewhere to the north toward Hopewell Junction and east toward Stormville. The discussion of the structural features will bring out the fact that there must have been a strong tendency toward crushing and mashing along the limbs of minor folds within this formation.

In the woods west of Wood's greenhouses at Fishkill Village are numerous outcrops of a very fine-grained metamorphosed rock which suggests an altered silicious ooze. It was noted in several places within short distances of each other and not far from ledges carrying Ophileta compacta. It appears to be a rather abrupt variation of the rock with which it is associated, and probably is to be regarded as a variation of the Beekmantown.

Certain varieties are plainly the products of metamorphism and will be referred to again under that heading.

In most cases, the lithology of the Fishkill limestones does not convey anything definite of which one may make use for provisional correlation. In the new cuts along the road from Brinckerhoff to Stormville even the fresh surfaces convey very little. In some of the ledges near Gayhead[1] the fresh surface carries numerous rusty patches, possibly siderite, which recall some surfaces seen in the quarry at Stoneco.

The magnesian character of some of these limestones is well known. There is some reason for thinking that they were accumulated in somewhat restricted bodies of water. Possibly they are partly the products of precipitation from saturated solutions.

If during the time these deposits were accumulating there were several basins more or less completely cut off from each other, it is easy to understand that there would have been some diversity in the condition of sedimentation in this region. In some places there would have been normal marine conditions with characteristic animal forms, while in others, perhaps, there would have been an accumulation of sediments peculiar to basins more or less completely cut off from the sea with an absence of animal forms. An influx of the sea in these restricted basins would carry with it a change in sediments and a marine fauna and a fossiliferous lens might thus be produced within a barren dolomite.

The absence of the conglomerate and overlying formations over most of the Fishkill limestone indicates that it is composed chiefly of older strata, probably ranging discontinuously from Lower Cambric to Beekmantown. As the folds in the limestones are moderate swells the older masses have not been exposed, except where faulted. Much of the surface rock may be of Beekmantown or Upper Cambric age, the latter belonging to the upper dolomitic layers of the sediments of that epoch.

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[1] East Fishkill is invariably referred to as " Gayhead," in this region. The name seems to have originated from the head adornments of the ladies who flocked to this place for dance festivals in early years.

Structural features. The hiatus that is present between the Beekmantown and the Trenton within the Wappinger creek belt has its counterpart along the western margin of this limestone; but the failure to find any conglomerate farther east, such as usually represents the base of the Trenton, not only in the Wappinger creek belt and along the western margin, but also in the slates at the north, leaves much uncertainty as to the relative stratigraphic position of much of this Fishkill limestone. The presence of certain faults adds to the perplexity; while the general faulted position of the Fishkill limestone as a whole and the absence of the slates within it rather leaves the impression that it is made up chiefly of limestones older than the Trenton conglomerate, except where younger beds have been faulted in.

In spite of faults and thrusts the general folded arrangement of the Fishkill limestones can in some instances be made out with a fair degree of exactness.

In the hamlet of Wolcottville the limestone is in contact with the gneiss. In the town of Matteawan it first rests against the slates, which are almost certainly younger, and then on the gneiss, then on the quartzite and finally on the gneiss again. The quartzite contact may be normal. The gneiss contact may also be normal in places, but in such cases the gneiss is presumably the equivalent of the basal quartzite and represents an altered condition of the gneiss.

The fault on the west of the Glenham belt represents an early thrust which was succeeded and outstripped by the Bald hill thrust. The western break also bounds the Matteawan inliers at the west. Faults bound the Glenham belt on the south and the northern inlier of Matteawan on the north and between these the slates have apparently been dropped.

Numerous breaks may occur in Matteawan so that the limestone resting on the quartzite in that town may not be of the same age as that which rests against the slates. The limestone is traceable to the north across Fishkill creek and through Glenham and beyond. But as a rule not much can be made out about the structure.

At Wilsey's quarry on the Fishkill-Glenham road the arenaceous limestone strikes n. 35° e. and dips about 51° s.e. In the field just north the fossiliferous Beekmantown and interbedded limestones have a strike varying from n. 15° w. to n. s. and a dip of 35° e. One-half mile to the northeast the dip is gently away from the gneiss and the strike cuts across it at a small angle. This general relation holds to the Chelsea road.

The topography southeast of Fishkill Village is very flat. There are few outcrops north of the Fishkill-Glenham road, between it and the woods, until the farm of Albert Haight is reached and none to the south of it until Glenham is reached. Low ledges of limestone appear north of Fishkill Village. Between the Chelsea and Wappinger Falls roads and north of that road and the Cold Spring turnpike they are abundant.

Just north of the village on the west side of the road, to the south of the cemetery, the strike is n. 55° e. and the dip 35° s.e. (lettered B in section figure 23). Farther north on the roadside near the gneiss the strike is n. 15° e. and the dip 49° n.w. (lettered A). At the railroad crossing on the Cold Spring road the strike is n. 80° e. and the dip 46° n.w. (lettered C). Southeast of Fishkill creek and northeast of the Cold Spring road, from a point a short distance from the road as far as Milton Hustis's farm, the strike varies from 25° to 40° east of north and the dip is toward the mountain and according to readings taken varies from about 50° to 62° s. e. (lettered D). Along the road from Fishkill Village to Brinckerhoff, about one-half mile from Main street in Fishkill Village, the strike and dip are about the same as at the railroad crossing. Along the northwestern margin of the limestone to the northeast of the Wappinger Falls road the strike and dip are not easily followed. Along a section in a northwest-southeast direction from the Glenham belt through Fishkill Village to the northwestern base of the Honness spur, as shown on the map and the accompanying section (fif. 23), the limestone is in a series of northwest-southwest folds which have suffered great erosion and, at places, much disturbance. The latter is shown along the highway and in the railroad cuts southwest of Brinckerhoff, where the strike is only at a small angle to the east of north and at one place n. 50° w. with easterly dip. Northeast of Brinckerhoff the strike and dip return to the former general direction. In the railroad cut just north of the Johns-

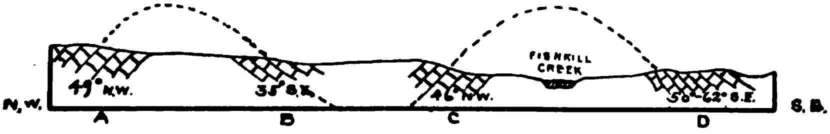


Fig. 23 Section across the Fishkill limestone along a northwest-southeast line through Fishkill Villagef rom the G'enham gneiss to the Mount Honness spur, to show the character of the folds Distance 2 miles

ville road they are n. 30° e. and about 43° s.e., and one mile south of Hopewell Junction n. 44° e. and 45° s.e.

The western slope of Bonney hill has the appearance of a fault scarp and shows numerous outcrops of limestones dipping to the east. Along the road leading south from Bonney hill, at the north to the east of the road and at the south to the west of it is another scarp with easterly dips. South of Bonney hill a northeast-southwest break apparently intersects this fault and the limestones north of Johnsville lie in the angle between them.

The section (fig. 24) along the railroad cut east of Hopewell Junction shows some structural detail. Heavy erosion has obscured the larger features and has brought out the minor ones. Beginning at the west, the section is first through beds dipping gently eastward, and apparently bordered on the west by the northward continuation of the fault that follows the road southeast of Bonney hill. East of this it is through a symmetrical northward pitching anticlinal shown in plate 13, and complemental synclinal, then in a smaller anticline and syncline, and then through an irregular fold with its eastern limb pushed up. This is followed by a closely compressed syncline which is succeeded by a closely-folded overturned anticline (see plates 14 and 15); then two small folds which are cut off at the east by the fault shown on the map.

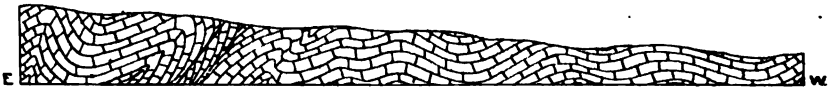


Fig. 24 Generalized section of the south wall of the railroad cut east of Hopewell Junction

East from here along the railroad the sections are fragmentary. In the second cut east of the overhead bridge on the road from Gayhead to Gregory's mill, the limestones show an arrangement like that of figure 25. Just west of Stormville station the beds are isoclinal, dipping to the east, and show a considerable aggregate thickness.

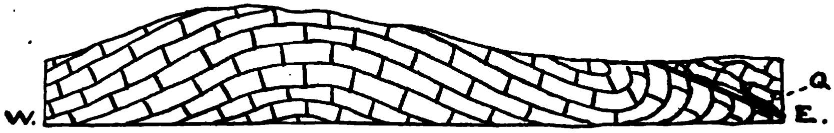
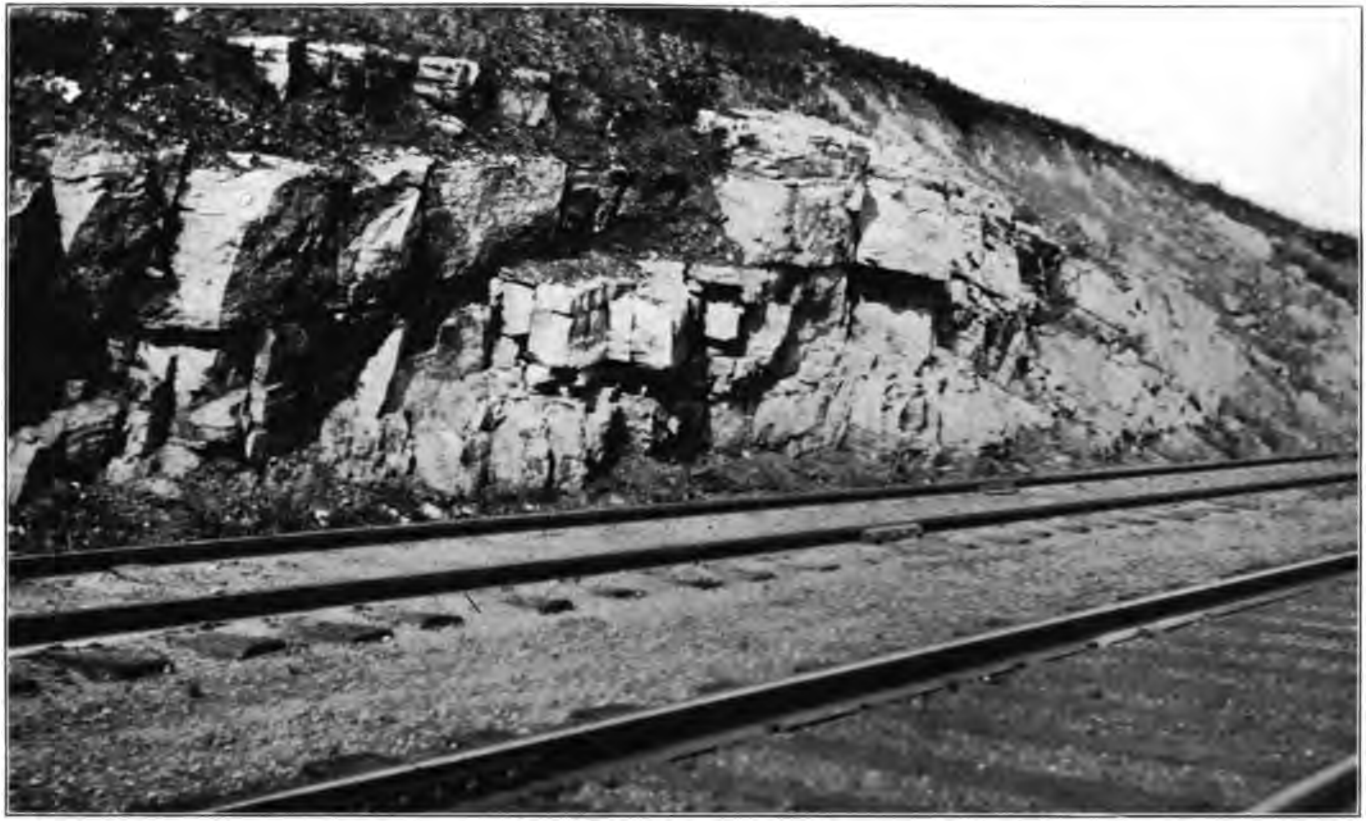


Fig. 25 Section just east of the overhead bridge on the railroad between Hopewell Junction and Stormville. *Q*, nest of quartz

The tendency to arrangement in somewhat gentle folds is shown by numerous observations. In some places the dip is east and at

Plate 13



Anticlinal fold in the limestones at the western end of the railroad cut east of Hopewell Junction. The axis pitches gently to the north

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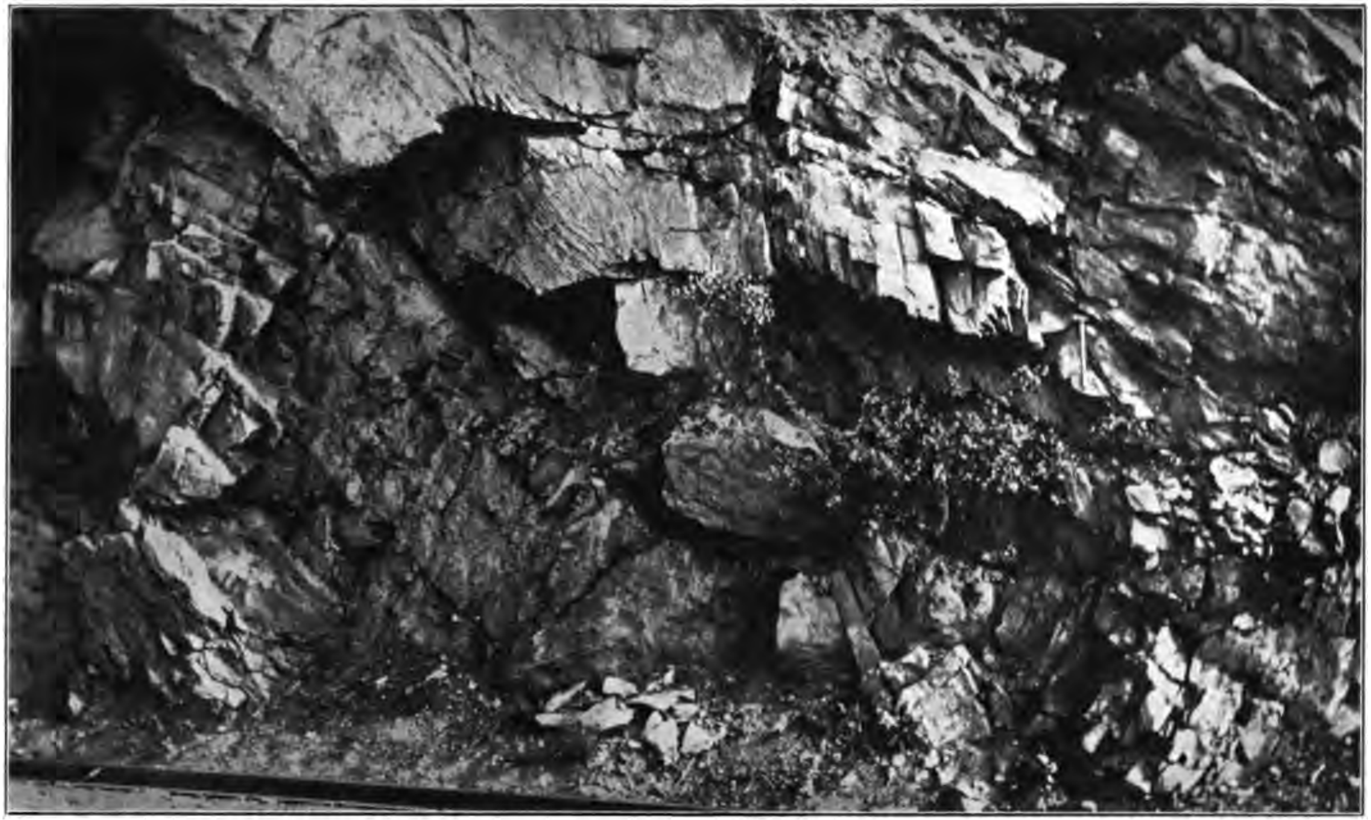
Plate 14



Compressed and overturned syncline in the railroad cut, one mile east of Hopewell Junction. Note the compression along the axial plane and the thrust along the overturned limb. The axial plane dips eastward

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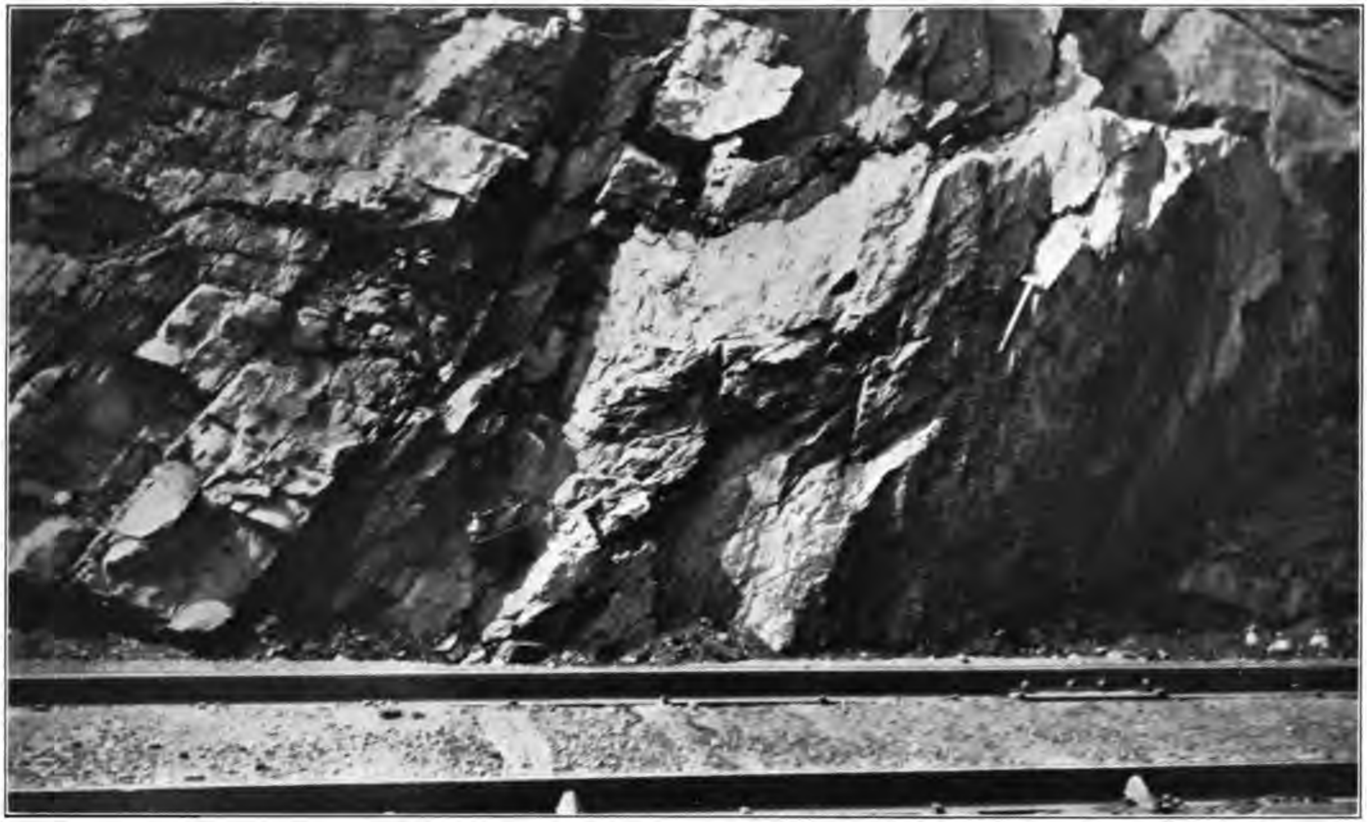
Plate 15



A view in the railroad cut about one mile east of Hopewell Junction, showing an overthrust on the left and a compressed syncline on the right marked by the hammer. The dip is eastward

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others west. The strike remains practically unchanged for some distance in many instances for beds with the same general dip. The limestone differs from the slate at the north with its isoclinal arrangement over wide intervals.

The tendency to overthrust, shown in the section along the railroad, probably prevails over the entire area. Strike faults are most apparent. The regularity of the strike for long distances seems to indicate that horizontal offsetting has not been important. Two large breaks along the strike are shown on the map. They are shown in the field by long stretches of swampy lowland that may be followed for several miles across country. They seem to be the northward projection of faults in the Highlands. The presence of these large breaks and minor ones complicates the question of the age of the limestone. The displacement must have been a large one at places as, for example, along the fault line that bounds Shenandoah mountain on the east. Possibly beds of very different age lie in close proximity.

Metamorphism and alteration. Were it possible to trace continuously from west to east the beds now known to be present along the western margin of this limestone, more could be definitely determined about gradation in metamorphism to the eastward. Examination of the belt has shown that the rock usually displays greater crystallinity as one goes eastward. Banded limestones not very different from some seen in the Dover valley were noted near Gregory's mill. There is much evidence of crushing. Bunches and veinlets of calcite and quartz nests and stringers are abundant. These indicate hydrothermal activities. Organic remains have doubtless been obliterated by these as well as by crushng, shearing and pressure.

Summary. The Fishkill limestone, in its relations to the slates, stands essentially as a huge faulted block. Though less plainly shown, the same is true of its relations to the Highlands mass. This arrangement has produced a northwestward gradation by faulted blocks from older to young masses. These considerations afford further reason for believing that the Highlands owe their present elevation to the mountain-making processes that gave birth to the Green mountain system and that the younger rocks once had an extension much to the south of their present southern limit, thus giving an altogether different notion of the early relation of the Paleozoic sea to the Precambric land from that which the present topography might be assumed to show.

The northward projecting spurs of the Highlands indicate a tendency to fold with the younger series, but owing to their crystalline condition and high coefficient of elasticity the gneisses broke and were thrust up into the younger rocks, in some places carrying the latter with them, and in others overriding them. The West Hook series was apparently first thrust up and then dropped back and has thus been preserved.

The arrangement in echelon of transverse faults along the northwestern margin of this limestone belt seems to show the influence of the gneissic substratum on which it rests.

The northward pitch of the younger rocks, which is observable in places, may be as readily explained as the result of greater vertical movement at the south as of original inclination.

The Mount Honness spur is plainly faulted on the north and shows numerous transverse gaps (see plate 2).

The abnormal position of the Lower Cambric caused much confusion in early years and led to its assignment to the Potsdam on the basis of its apparent stratigraphic position.

The occurrence of numerous faults in the quadrangle suggests that the apparent absence of a Middle Cambric might thus be explained.

The evidence now in, although in great need of being supplemented, shows that the limestones of the Fishkill belt are, in part, the eastward representatives of those of the Wappinger creek belt.

THE "HUDSON RIVER" SLATE GROUP

The term "Hudson River" is used in this paper for the slates of the quadrangle because of the extensive section displayed in these rocks along the Hudson river and because the name is both widely known and locally followed by those who refer to the members of the slate formation. It is used only as the equivalent of other names employed in this paper and entirely without reference to the value of the term "Hudson River Group."

Distribution and general relations. Members of this formation underlie the major part of the quadrangle. At the present time there are no representatives of it within the Fishkill mountains or the Fishkill limestone of this quadrangle. Northwest of these rock masses the Hudson River rocks are the prevailing ones. The limestones of the Wappinger creek belt are faulted in with the slates. Northwest of this belt the slates entirely conceal the limestones. North of the Fishkill limestone block are several small patches of limestone within the slates which will be described with this formation.

Terranes present. Mather described the members of this formation under the headings, "Hudson River Group," "Utica Slate" and "Trenton Limestone Group."[1] He wrote of fossils being found in the "slates and slaty altered limestones that would not be recognized as limestones without close examination." The locality was about one and one-half miles north of Barnegate[2] and the fossils were recognized as belonging to the Trenton limestone.

In 1878 T. Nelson Dale[3] discovered fossils in the slates near Vassar College and "on the Stormville road between Casper creek and the first limestone ridge." Mr Henry Booth, of Poughkeepsie, and students at the college found other fossils at the ledge near the observatory at Vassar. The writer has also found fossils there.

In company with Mr Booth, Mr Dale discovered other fossils on the west of the Hudson opposite Poughkeepsie. This locality is on the eastern slope of "Illinois mountain" southwest of Highland.[4]

The fossils discovered by Dale were identified by Hall as: Orthis (Dalmanella) testudinaria, Orthis pectinella, Leptaena (Plectambonites) sericea, Strophomena alternata, Bythotrephis subnodosa, Bellerophon bilobatus and crinoid stems. Specimens of the first five named are in the Vassar Institute Museum at Poughkeepsie and are labeled "Highland, N. Y." O. (D.) testudinaria and L. (P.) sericea were found on both sides of the river. Dale thought these fossils verified Mather's use of the term "Hudson River Group." Certainly these strata belonged to some member of the Trenton period.

The first three types mentioned have also been reported from Marlboro-on-the-Hudson about nine miles north of Newburgh. They have also been found in the slates at the northern end of the New Hamburg tunnel.[5] The writer has found fossils here, including O. pectinella, in the shales under the bank, back of the boathouse.

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[1] Geology of the First District. Part IV, p. 369, 390, 397.

[2] *loc. cit.* p. 401.

[3] Amer. Jour. Sci. Ser. 3. 17:56-59.

[4] Directions for reaching this locality were furnished by Mr Henry Booth. Take Modena road from Highland south one mile to cemetery, then wood road through cemetery to mountain. Fossiliferous ledges occur 150-200 yards up the mountainside.

[5] J. M. Clarke. Guide to the Fossiliferous Rocks of New York State. Handbook 15, p. 6.

Crinoid stems have also been found at Marlboro. L. (P.) sericea and O. (D.) testudinaria were found on both sides of the Hudson as rather abundant and characteristic.

The only other fossil locality in the slates which was found by the writer, and which appears to be new, is at Swartoutville. At the western edge of the large field across the road from the house of Irving Hitchcock is a ridge composed of fissile, gray sandy shales with interbedded, dense blue impure limestones.

The shales stand almost vertical, dipping slightly to the west and strike diagonally across the ridge, so that in going from south to north along the ridge one passes over probably older beds. The interbedded limestones are of dark blue color and carry numerous traces of organic remains. The fissile shales have yielded Plectambonites sericeus, and fragments of indeterminable fossils.

Relations are very obscure, but one or two small outcrops of limestone conglomerate were noted between these strata and the bluish-gray limestone a short distance to the east. In their structural relationships the fossiliferous shales probably belong with the limestones and are probably near the base of the slate formation. The slates at the west are younger. The amount of displacement between them is wholly problematical.

In 1883, during the construction of the railroad along the west bank of the Hudson, Messrs H. Booth and C. Lown of Poughkeepsie discovered graptolites in the newly-made cuts at two localities, one two miles south of Highland and the other about one mile north, near the place where the icehouses now stand. These graptolites were identified by Whitfield as follows [the correct names have been added in brackets]: Diplograptus pristis Hall; Climactograptus bicornis Hall; Dichograptus [Dicranograptus] furcatus Hall; D. [Dicellograptus] divaricatus Hall (?); Monograptus [Nemagraptus] gracilis Hall; M. [Didymograptus] sagittarius Hall; Diplograptus marcedus Hall. [Cryptograptus tricornis]. He considered them as of Utica age. A graptolite identified as Graptolithus [Amphigraptus] divergens was also reported from the slates one and one-half miles north of Poughkeepsie on the east bank of the Hudson river. This specimen is in the Vassar Institute Museum at Poughkeepsie.

Some of the slates within the quadrangle are shown by these discoveries to be younger in age than the so-called Trenton conglomerate of the area. Some may be contemporaneous and probably are;\ others are possibly much younger. The relations farther north, in Washington county, have shown that the Lower Cambric slates have been brought to the surface by faulting, but within this area it has not proved possible to determine this. On the whole, it does not seem probable.

The general problem of the slates is postponed until several features have been stated in detail.

Red slates. Red slates with green bands of varying thickness may be traced at intervals diagonally across the quadrangle, along the prevailing strike, from Matteawan to the northeastern corner of the area. Their regularity of recurrence indicates that an important stratum is involved in the folding. The main stratum of these red slates as shown in several places has a fairly uniform thickness. Thinner red bands have rarely been noted in the more common grayish-black members of this formation.

In the town of Matteawan red slates with green bands form thick masses along the banks and bed of Fishkill creek as far as the carpet mills at Wolcottville, and north of here at Glenham along the road from Matteawan to Fishkill Village, just west of the Glenham gneiss belt, ledges of these rocks are abundant. The red slates are locally called the "paint rock." Farther north along the strike they were noted north and south of the road from Fishkill Village to Chelsea and along the road from Swartoutville to Hughsonville. A thick band occurs along the New York Central Railroad track one-fifth of a mile south of Paye's clay pits and a similar band just north of the station at Chelsea. They were not noted farther north along the river section. The slates at Chelsea continue northeast along the strike and appear one mile north of New Hackensack along Wappinger creek, and again near Manchester Bridge and at Overlook; also frequently along the roads from Pleasant Valley to Moores Mill. At the north they appear oftener, chiefly because of the more frequent and larger outcrops of the slates and the thinner covering of surface material.

There are reasons for thinking that the slates form a synclinal fold west of Matteawan and possibly the red slates at Matteawan and south of Paye's pits respectively represent the east and west limbs, while those at Chelsea may represent the western limb of the succeeding anticline.

Associations of the red slates. Along both the north and south roads from Pleasant Valley to Moores Mill the red slates occur just to the west of small conglomeratic limestone patches that have plainly been brought up by faulting. There is no way of determining the amount of displacement, but it is reasonably clear that the red slates lie above the limestone and are younger and probably are not far from the base of the slate formation.

Along the New York Central tracks near Fishkill Landing station are heavy-bedded members of the slate formation, such as make up most of it northwest of the Wappinger creek limestone belt. Assuming that the slates west of the Glenham gneiss belt have synclinal structure, these heavy members can not be far from the axis of the fold and lie several hundred feet above the red slates in stratigraphic position. The reason for the gneiss being in contact with, or in proximity to, the red slates along the Glenham belt, while the limestone conglomerate has that position at the north, is clearly due to greater vertical movement of the older rocks at the south and west.

The red slates have not been noted within this quadrangle northwest of the Wappinger creek belt. According to the writer's observations, the companion members of the red slates southwest of that belt, although sometimes showing heavy beds and even fine conglomerates like those seen at the northwest, are prevailingly more fissile and splintery mud rocks of blackish-gray color. These also occur along the northwestern margin of the Wappinger belt, but farther northwest give way to beds of coarser sediments.

Quartzite near Rochdale. Along the road from Manchester Bridge to Pleasant Valley, east of Wappinger creek, between the farm of A. W. Sleight and that of George E. Smith at Rochdale, are prominent ledges of compact quartzite which rather strongly resembles some varieties of the basal quartzite. These ledges are portions of a continuous strip which can be traced from a ledge on the farm of A. W. Sleight just north of the Overlook road northward, roughly parallel with the Pleasant Valley road, to George E. Smith's house. Just south of here it crosses the road and ends at the bank of the creek west of the house. East of the road it ends just beyond the barn south of the brook shown on the map, which apparently occupies a fault between the quartzite and the slates to the north of it. This quartzite is bounded entirely by the slates, except where it disappears in the creek. Here it is only a short distance from the Trenton limestone at Rochdale. Along the eastern contact with the slates, about one-half mile south of Smith's house, the quartzite shows a strike of n. 20° e. and a dip of about 60° e. A mile and a half to the southeast, on the farm of Eugene Storm at Overlook, is a large block of compact whitish quartzite identical in character with that just described. This is cut off by a fault at the south against the slates. It can be traced only a short distance northward and disappears beneath the drift. This mass apparently belongs with the strip first described.

This quartzite is probably an interbedded member of the slate formation. Its exact equivalent has not been noted elsewhere within the quadrangle.

MISCELLANEOUS FAULTED LIMESTONES WITHIN THE HUDSON RIVER FORMATION

Arthursburg. Three small patches of limestone are faulted in with the slates at Arthursburg. One of these is near the Central New England Railroad station. The impure shaly limestone is exposed in the railroad cut and forms a conspicuous knoll, which is situated partly on the railroad property and partly on the estate of Obed Hewitt. It is bounded on all sides by the slates and is hardly more than one-fourth of an acre in extent. It occurs along the north ward projection of the line of faulting that farther south forms the western boundary of the angular portion of the Fishkill limestone north of Hopewell Junction. Its present position is due to this fault and marks its northward continuation. A careful search showed that the limestone does not occur in the neighborhood to the west of this fault.

A few hundred yards to the northeast of the station, on the road ascending the hill toward Beekman, conglomeratic limestone, with pebbles squeezed and elongated, outcrops along the road just north of the old schoolhouse.

One-fourth of a mile north of this outcrop on the farm of G. L. Wiley, just southeast of the private cemetery, the limestone is exposed on a knoll just north of the brook. Some bluish-gray beds, like those seen at Rochdale, are present. The conglomeratic facies is absent. The beds strike n. 10° w. and dip 55° e. The knoll is entirely surrounded by the slates. The topography suggests a fault more or less parallel with the brook at this place. The fault just referred to as projected north from the Fishkill limestone dies away to the northward.

An unmistakable fault passes southeastward from Arthursburg and intersects the strike fault that follows the line of the old Clove branch railroad bed.

The shaly beds near the station are probably younger than the conglomerate, while the latter is probably younger than the mass near the cemetery from which the conglomerate may have been eroded. These small masses are all separated from each other by the slates and no others could be found. They are clearly small faulted inliers of the older rocks lying near or at the intersection of two faults, one of which exactly parallels a similar break bounding the Fishkill limestone just south, while the other is the northward continuation of a fault between that limestone and the slate.

The fault features which mark the Highlands and the Fishkill limestone thus continue northward within the slate formation.

Moores Mill. On the farm of Mr Skidmore, about one mile west of Moores Mill station, is a larger mass of limestone resting against the slates. It extends up the hill on the northwest side of the road and for a short distance through the woods, but on the west, north and east gives way to slates. On the southeast it passes beneath the flood plain of Sprout creek. The entire patch does not exceed an acre or so in extent. In the orchard west of Skidmore's house the slate and limestone are mixed together. The limestone is of a gray color and somewhat crystalline and seamy, but has no distinctive character. No satisfactory readings could be obtained.

East of the creek, one-half mile from Skidmore's house, on the farm of Mr Houghtalin, is a small, precipitous ledge of limestone in place, apparently dipping to the east at a high angle. This ledge is in the angle formed by the two roads northeast of Houghtalin's house. The topography just south of the ledge is that of a scarp, which continues for one-third of a mile southwest. The scarp slope for this distance is uniformly abrupt, but outcrops are concealed south of Houghtalin's. The topography suggests a transverse break at the south along the line shown on the map. South of this break, along the base of the slope, outcrops are concealed by surface material for some distance, but farther on the slates outcrop in low-lying ledges and in some places lie close to the base of the slope.

The discovery of these two limestone patches aroused the suspicion that the valley of Sprout creek might be in the limestone, but careful search failed to show the limestone in any other outcrops with one doubtful exception. Along the bank of the creek, one mile northeast of Skidmore's farm, a mass of limestone about fifteen feet square was found between the road and the brook. At the base it is made up of coarse limestone conglomerate, which is followed by arenaceous limestone. This is succeeded by a finer-grained conglomerate. The apparent strike is n. 25° w. and the dip 34° n.e. This was regarded as a boulder. It strongly resembles similar beds found in place to the northwest. It hardly seems probable that this small ledge would have been preserved in its present position.

It is reasonably apparent that these two limestone patches have been brought to their present position by overthrust faulting, involving a horizontal displacement of at least one-half a mile. At Skidmore's the limestone has been eroded so as to expose the slates on which it has been thrust. The small ledge at Houghtalin's is only part of a scarp which is for the most part concealed.

The valley southwest of these two limestone patches is plainly in the slate. There is strong suggestion that it is along a line of strike faulting that extends from the Highlands northward beyond the limits of the quadrangle. The view which shows this best is that obtained from the western slope of the ridge southwest of Moores Mill. The conspicuous scarp on the west of the high hill west of Lagrangeville, which is seen so distinctly from Freedom Plains, lies along this line of faulting, while the northeastward continuation of the latter is marked by a hollow plainly visible at the elevation of the viewpoint just mentioned.

East of Pleasant Valley. Three limestone masses are faulted in with the slates east of Pleasant Valley. The largest of these is farthest east of the three and is shown on the map along the north road from Moores Mill to Pleasant Valley. A small ledge of the limestone outcrops among the slates one-fourth of a mile south of the fork in the roads near Ivy's house. This is separated from the main portion of the mass along the road by slates. East of Ivy's house, occupying practically all of the small triangle formed by the roads as shown on the map, and north of here for several hundred yards, are ledges of conglomeratic limestone interbedded with silicious limestones (silicicalcarenytes[1]) and limy shales. The dip is eastward. Low ledges of limestone outcrop on both sides of the road east of Ivy's. On the east side of the road the conglomeratic member forms a scarp for some distance. The pebbles of the conglomerate are squeezed out into a stringerlike appearance along the strike.

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[1] A name proposed by Professor A. W. Grabau for silicious limestones with sandy texture.

At the east this limestone patch gives way to the slates. At the south limestone and slate are somewhat mixed. At the west the patch evidently rests by overthrust on the slate formation. At the north relations are very obscure. It probably dies away along a strike fault.

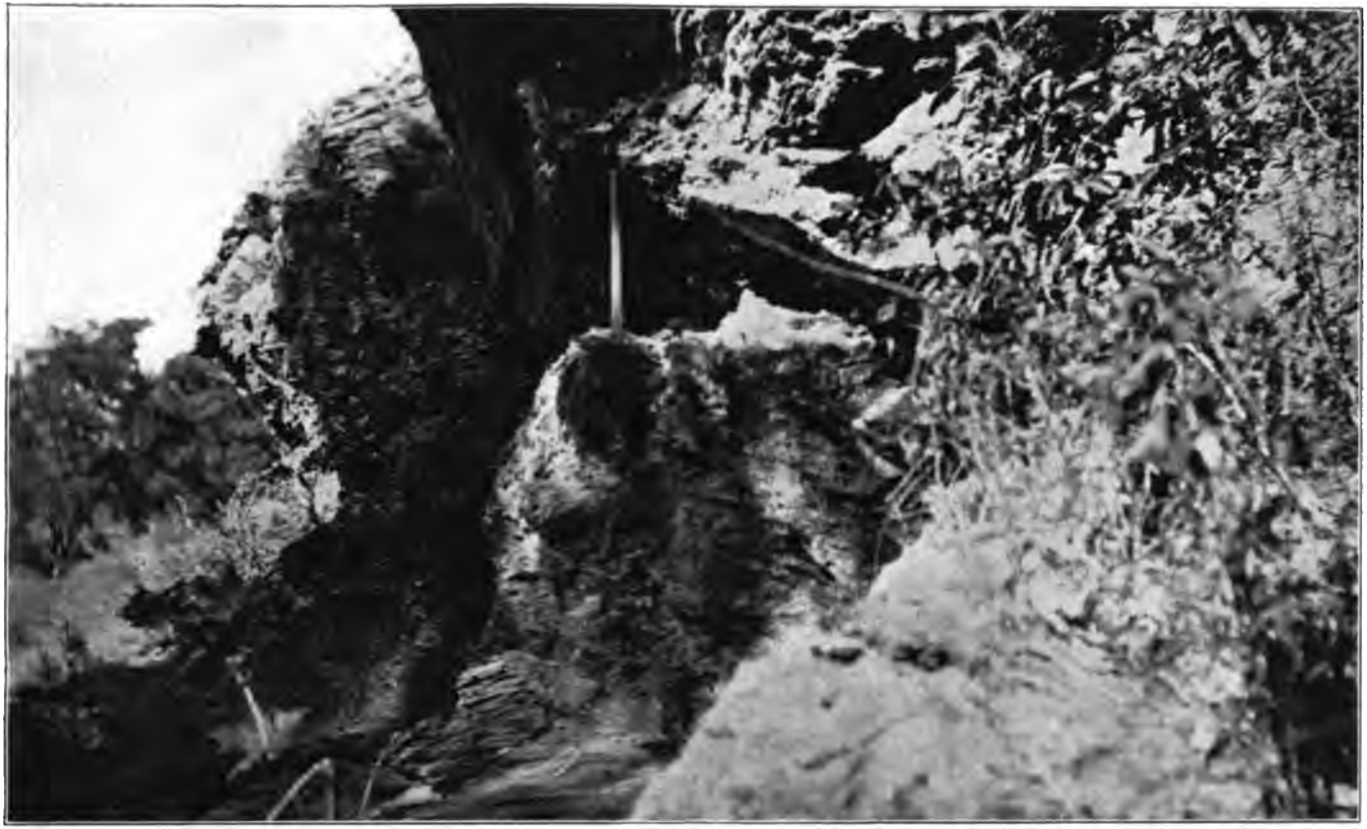
Distinct fossil traces were not noted here. The silicious limestone often shows many rusty grains. The red slates outcrop less than one-fourth of a mile to the west.

Farther west, along this north road, about one and a half miles east of Pleasant Valley, as shown on the map, squeezed limestone conglomerate and interbedded silicious limestones form a knoll north of the brook and outcrop along the crossroad leading north. The limestone dies away at the north and is entirely surrounded by the slates. This block is along the line of thrust that brought up the third patch to the south of here along the south road to Moores Mill.

About two miles southeast of Pleasant Valley is another patch of limestone conglomerate with associated silicious limestone. The latter here is often weathered and shows a distinct clastic rock with fine quartz grains predominating. The weathered surface is pitted and the rock friable from loss of the lime constituent. This rock could be equally well designated as a calcareous quartzite. It is very similar to the rock overlying, or interbedded with, the conglomerate near Ivy's house farther east, but perhaps is a little more silicious. It carries the same rusty grains. The writer was interested to compare this rock with specimens collected from the Sprout brook limestone near Peekskill and was surprised to note the strong resemblance in texture, mineralogy and markings.

This patch lies back from the road, about 500 or 600 yards east of J. Fleet's house. It forms a distinct scarp which continues south in the slates along the road after the latter makes its southward turn just east of Fleet's house. A thick band of the red slates comes in between this scarp and Fleet's house and is crossed diagonally by the road. The conglomerate rests by overthrust on the slates at the west. This feature is shown at "Fox Hole," a local name for the precipitous scarp shown in plate 16 and figure 26.

Plate 16



Overthrust of the conglomerate on the slates east of J. Fleet's farm, southeast of Pleasant Valley

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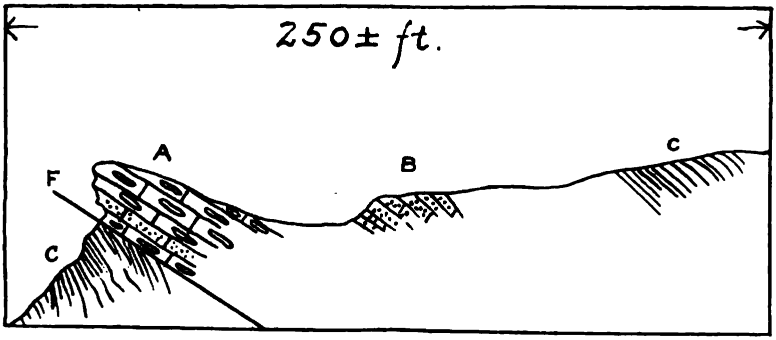


Fig. 26 Overthrust east of John Fleet's. *A*, limestone conglomerate; *B*, silicious limestone; *C*, slate; *F*, fault

When seen from above the conglomerate is coarse, but when examined along the edges of the eastwardly dipping beds the pebbles are seen to be squeezed out into stringers, so that the apparent coarseness can not represent the original condition. The dip is about 20° e. and the strike about n. 10° e. The calcareous quartzite was not seen in actual contact with the conglomerate, but is undoubtedly conformable. At the east the former is followed by the slates. Solenopora compacta, showing the characteristic very fine lines, was noted in the conglomerate. The quartzitic rock outcrops at intervals to the south for one-fourth to one-third of a mile, but gradually dies away. At the north the series ends more abruptly.

The conglomerate at the last mentioned locality of those which have just been described is undoubtedly the equivalent of that which at Pleasant Valley and Rochdale overlies the eroded Beekmantown, and there can be little doubt but that the conglomerate at the other localities is also the same. There is shown again the general tendency for the older rocks to be faulted up among the younger ones.

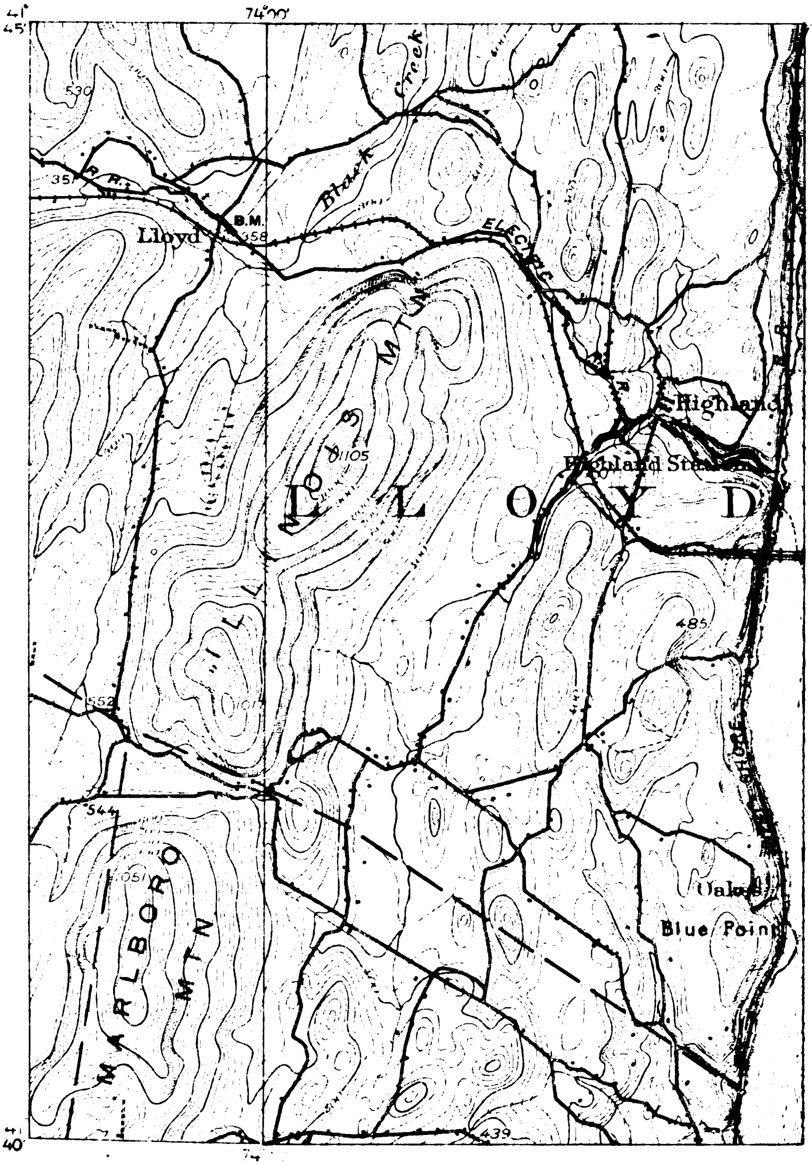
Summary of features shown by the conglomerate and associated rocks. At Pleasant Valley and at Rochdale the conglomerate and overlying or interbedded blue limestone resting on the eroded Beekmantown are prominently developed. At Rochdale the series is from 70 to 100 feet in thickness and at Pleasant Valley it is apparently about the same. At Sleight's quarry near Manchester Bridge the conglomerate and blue limestone is from 20 to 30 feet in thickness, but certain faulting here makes it unsafe to regard this change as marking a thinning of the limestone. Farther south along the Wappinger creek belt one can get no idea of the extent to which this basal series is represented. Along the western margin of the Fishkill limestone, as shown east of the Glenham belt, the conglomerate has plainly been eroded so extensively that no idea of its original thickness can be gained. At Swartoutville the conglomerate is apparently thin and passes quickly into a series of interbedded bluish limestones and gray limy shales. The impure shaly limestones along the railroad track west of Hopewell Junction, at the apex of the limestone angle and those near Arthursburg station, are probably near the base of the slate formation. At Arthursburg the conglomerate is present at a distance of a few hundred yards from the shaly limestones at the station. In the localities east of Pleasant Valley, which have been described, the conglomerate is interbedded with and followed by calcareous quartzite, the blue fossiliferous mud rock not being present.

At the east within this quadrangle the rocks associated with the conglomerate, though varying in texture from shaly rocks to quartzitic ones, tend to be more silicious than those farther west. Folding and faulting have doubtless brought the two into their present rather close proximity.

Other varieties within the slates. This formation shows many varieties of more or less altered clastic rocks, ranging from muds to fairly coarse conglomerates. While folding and faulting have produced the greatest confusion, it seems possible to make out the general sequence. The writer's observations favor the idea that the calcareous conglomerate and overlying quartzitic limestone represent an eastwardly overlapping sea. These were quickly followed in some cases by limy mud rocks and in others by argillaceous ones. These were both succeeded by a clastic series of both argillaceous and calcareous nature with one and sometimes the other element in excess and occasionally with so much lime as to form an impure lime rock. The varieties varied in texture and followed each other irregularly. Impure argillaceous muds predominate, and are interbedded with limy muds and grits of varying thickness, but often attaining several feet. Grits often reaching conglomeratic texture are frequent. In these, the larger particles range from the size of a pin head through that of a pea to that of a walnut and larger.

On the whole, the finer-textured members are more characteristic of the basal portions of the series and the coarser and gritty layers of a higher horizon. Such a series as has just been described is folded in between the red slates of Matteawan and those south of the clay pits at Paye's brickyard, and the members are exposed at

Plate 17



West side of Hudson river showing location of Marlboro and "Illinois" mountains

many points between or along the strike to the north and south, and along the New York Central Railroad track. The coarser, gritty members, or conglomerates, were noted about midway between the strikes of the two bands of red slates.

The red slates suggest that they were formed under conditions of regular exposure to the atmospheric influences, perhaps on extensive tidal flats or river deltas. It is probable that these rocks were formed on a gently subsiding sea floor which occasionally allowed for partial nonmarine conditions of sedimentation. The relative horizon of the red slates is indeterminate, but is probably not far from the base of this formation. This is indicated by the geographical associations with the conglomerate and their absence northwest of the Wappinger creek limestone.

North of Camelot, along the railroad track, almost to Poughkeepsie, crushing has affected all members much the same, producing coarsely splintered slates. The great confusion exhibited by the slates about Poughkeepsie and on the west of the river north and south of Highland seems to have been due very largely to the effect of heavy beds interbedded with thinner ones.

Along the western bank of the Hudson from Marlboro to a point two miles or so north of Highland, the rocks are quite similar to those along the east bank. Westward from the Hudson the rocks grow prevailingly coarser. The section along the Central New England track between Highland and Lloyd shows thick masses of quartzitic rocks interstratified with coarse grits and conglomerates. The latter form relatively thin beds, perhaps from six to eight feet in thickness, often with pebbles from two to four inches in their longest diameters, embedded in a matrix of finer conglomerate; while in the grits are scattered pebbles ranging from the size of a walnut to that of a man's head. These coarser types prevail along the track west of Highland station and are particularly well shown just east and west of the overhead trolley bridge on the New Paltz road and at the foot of the mountain along the road just south. These rocks appear to be the northward continuation of the rocks of " Illinois mountain." That some of the strata were deposited under marine conditions is indicated by the fossils that have been discovered on the eastern slope of " Illinois mountain " and on Marlboro mountain farther south. While this is true, there appears to have been a gradual coarsening of sediments westward which suggests changed conditions in the source of supply, lying to the eastward, as though terrigenous sediments gradually encroached westward and contended with marine deposits. This idea would seem to fall in line with what we know of the record of closing Ordovicic time in eastern North America.

Some of the members of the slate formation on the west of the Wappinger limestone belt may be much younger than those on the east of it. They may be thought of as having been preserved partly on account of their occupying, in general, a downthrow position with reference to a tendency to thrust and reversed faulting to the eastward as well as on account of being west of the axis of maximum folding.

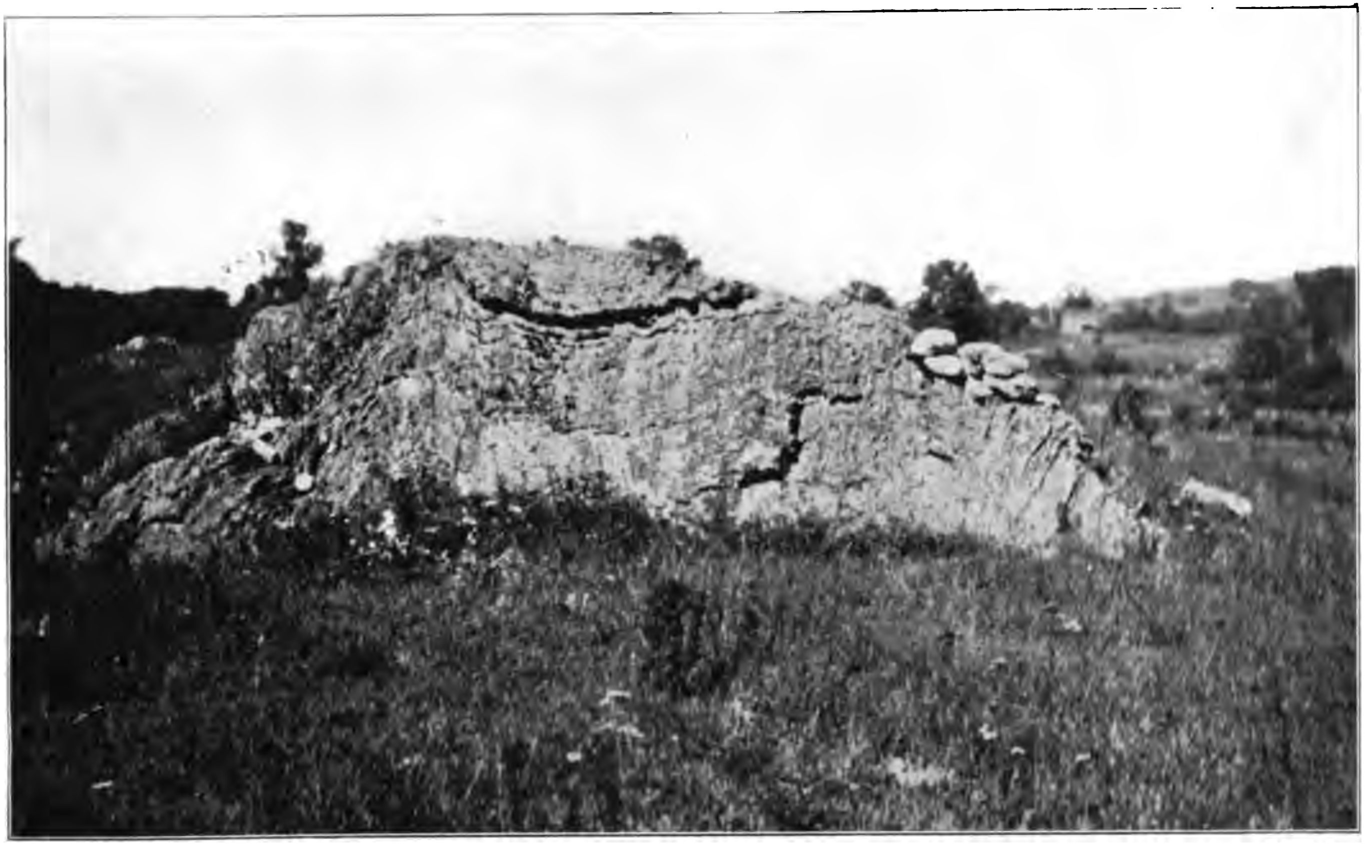
About two miles north of Poughkeepsie are strata of black, somewhat carbonaceous slates in which graptolites have been found. They indicate changed conditions of sedimentation from those which chiefly prevailed during the accumulation of these rocks. These black slates have been thought to be of Utica age.

Structural features. Where the stratification dip has been determined on what is plainly the limb of a fold, it is chiefly eastward. Judging from the conditions shown in the Fishkill limestone, the structure is that of minor folds within a system of larger ones with a tendency to overturning. The presence of strong cleavage [illegible] everything in surface outcrops.

The amplitudes of the larger folds seem to be smaller at the northeast [illegible] than at the southwest, and the folds seem to be more open at the north. The slate ridge just east of Freedom Plains, which rises abruptly at the south at a point due east from that hamlet, has a synclinal structure of a rather open character. At [illegible] along the western portion of its eastern slope it shows the strata dipping to the west into the hill. To the north, along the road from [illegible] Mill to Pleasant Valley, the [illegible] on the western limb of this syncline and about [illegible] a mile farther northwest they appear again apparently on the western limb of the succeeding anticline.

There was a tendency to form irregular folds. This is shown on [illegible] plate 18 in which we have a small overturned and [illegible] anticline on the right of the picture, followed by an [illegible] syncline, which becomes compressed and pushed up at the west, and then another compressed syncline not distinct in the photograph but similar to the first. In this instance, it is seen that the [illegible] of anticline and syncline in the middle part of the ledge has been incomplete. With similar tendencies prevailing in the larger folds, it is easy to see how, along the western portion of the irregular anticline, there would have been a tendency to overthrust. Crumpling is not uncommon. The wrinkles vary from

Plate 18



Folds in the slates on Ivy's farm, three miles east of Pleasant Valley

minute size to the dimensions shown in plate 19. These features are more common at the east.

Cleavage is so prominent in surface outcrops that the stratification dip is usually obscured. The prevailing eastward dip indicates a common eastward inclination for the cleavage. The presumption is that stratification and cleavage often coincide or approximate each other very closely. Where the cleavage is not dominant to the exclusion of the stratification, this fact is often observed.

Jointing is well displayed in Matteawan along the Newburgh, Dutchess and Connecticut track. A prominent set of joints shown here has a general strike of n. 20° e. and a dip of 80° w.

Some of the faults within the slates have been alluded to in describing the limestone patches within this formation.

Extending in a northwest direction approximately parallel with the road from Brush to Arthursburg, as shown on the map, is a clear transverse fault. This break is best seen from the southeast near the old railroad bed. This break intersects a line of strike faulting at Arthursburg, and probably ends at that point. The strike fault just mentioned dies away to the northward. Continued south, it bounds the limestone triangle north of Hopewell Junction on the west.

The high hill northwest of Lagrangeville is bounded by a fault scarp on the west. This scarp is a conspicuous cliff east of the road from Lagrangeville to Freedom Plains. The high hill northwest of Billings is bounded on the south by an east–west fault whose scarp is very conspicuous.

The other lines of fracture shown on the map have already been referred to.

A long line of swampy lowland, beginning two miles north of Freedom Plains and running northward toward Pleasant Valley, appears to mark a line of crustal weakness similar to that which extends from Hopewell Junction to Manchester Bridge.

The fault which bounds the western strip of the Wappinger creek limestone on the north may extend across the Hudson and bound " Illinois mountain " on the north.

Metamorphism and alteration. The members of the slate formation show an appreciable increase in metamorphism toward the east within the quadrangle, passing into slaty phyllites and graywackes. These rocks do not develop into perfect schists like those occurring a few miles to the eastward, but pellets of decomposed ferruginous particles, suggesting former garnets, were noted in the phyllites east of Arthursburg. Veins, veinlets and nests of quartz are most abundant in the northeastern part of the area. Sandstones have been changed into quartzites.

Summary. There is no evidence at hand that any slates of the quadrangle are older than the limestone conglomerate that has been discussed, either as overlying the Beekmantown or as isolated inliers within the slates. The slate formation was ushered in by this basal conglomeratic layer. The area of deposition of the latter may have been much more extensive than is indicated by its present faulted outcrops. The period of its formation was of short duration.

The most that can be said of the slate series is that it began in some horizon of the Trenton and perhaps ranges upward an indefinite distance into the Cincinnatian. Probably a large portion is of Trenton age.

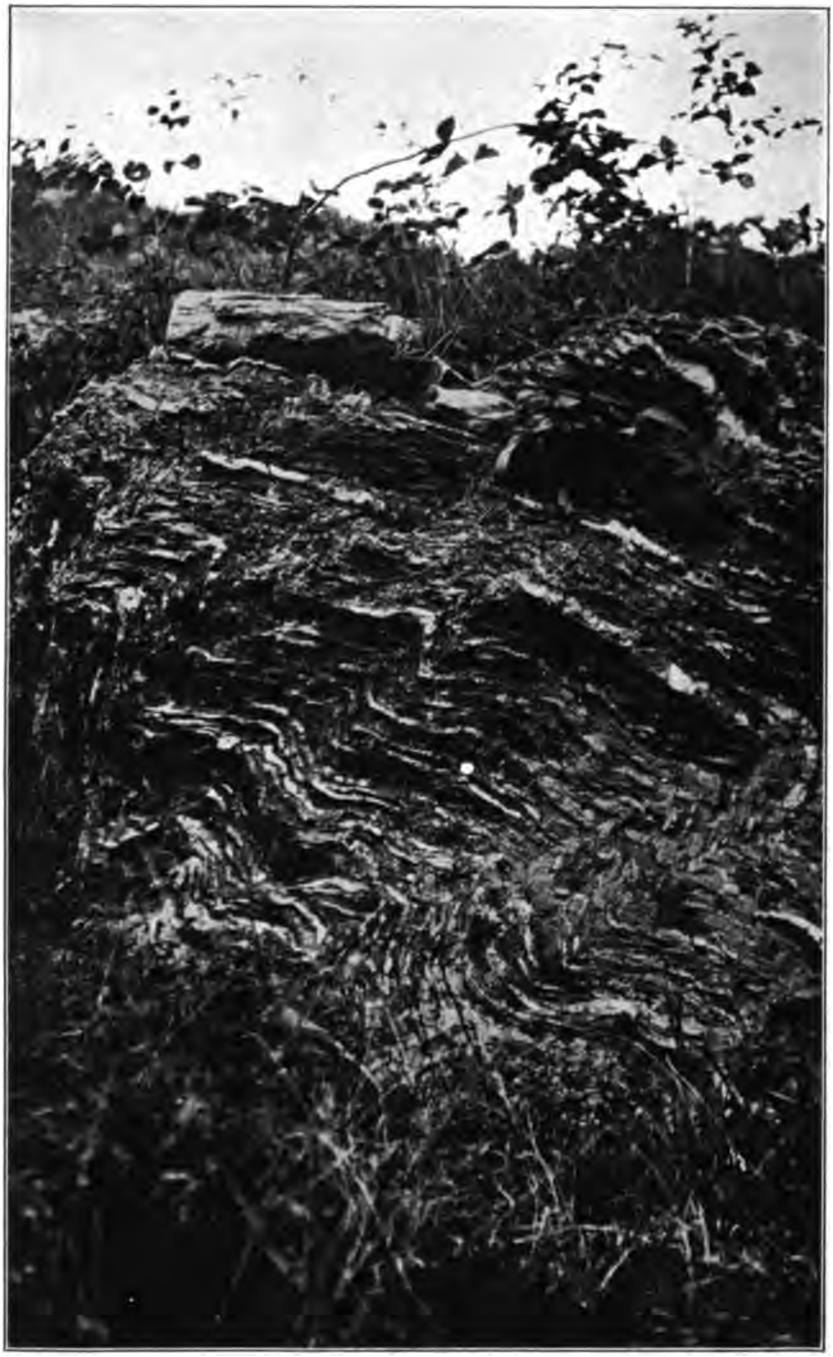
The Utica may be present, although the graptolite beds that have been so called more probably represent an early invasion of the Utica fauna in Trenton time in what is known as the Normanskill subepoch. Some of the slates may be contemporaneous with the Utica as developed elsewhere to the north, and possibly even younger; or they may all be of Trenton age.

PREGLACIAL HISTORY OF THE DRAINAGE

Old valleys of the Tertiary cycle. During the erosion cycle inaugurated by the Postcretacic uplift, the Hudson river then, as now, must have been the dominant factor in the drainage of this and adjacent areas. A broad valley region was formed and the tributaries of the master river steadily pushed their valleys eastward. The early Tertiary valley of the Hudson itself is now represented by old rock terraces preserved at different points back from the river's edge. Near Poughkeepsie they have an elevation of about 200 feet.

The rock valleys of the present tributary streams are in most cases out of proportion to the present size of those streams. During the time the Hudson river occupied the valley now marked by the terraces that have just been alluded to, its tributaries widened their own valleys a good deal and acquired their present open character. These branches formed a drainage system of the second order within the broad valley region of the main river and a somewhat advanced stage of mature topography was attained. During this time the various lines of crustal weakness became marked off into their present prominence, without necessarily becoming prominent lines of drainage; simply responding in a logical way, on

Plate 19



Crumpled slates east of Freedom Plains

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account of reduced resistance, to the base-leveling forces of the time.

Late Tertiary uplift. Late in the Tertiary cycle, probably during the latter part of Pliocene time, it seems probable that an elevation occurred which rejuvenated the whole river system. The Hudson began the construction of its present gorge and its tributaries began to deepen their valleys within their former confines. It has been suggested that the temporary shifting of the St Lawrence drainage through the valley of the Mohawk gave the main stream a tremendous advantage. It was able to sink its channel at a very rapid rate. The larger tributaries were able to deepen their gorges near their mouths and for some distance back from the Hudson before the glacier invaded the land.

Buried river channels. Borings have been made at different points across the Hudson river and its tributaries in connection with the location of the aqueduct of the great metropolitan reservoir in the Catskill mountains. These have yielded important data regarding the preglacial channels of these streams. Professor Kemp has summarized and discussed these data in an interesting paper.[1]

Borings across the Hudson have been made at Pegg's Point, at a point one-half of a mile north of that place, at New Hamburg and at Danskammer within this quadrangle, and at Storm King just south of Newburgh.

The most northerly line of borings is known as the "Tuff crossing." From this, only wash borings were secured. The river here is only 2200 feet wide.

At Pegg's Point the river narrows still more. A diamond drill was sunk 720 feet from the west shore and reached the slate at 223 feet below sea level. Another sunk 440 feet from the east bank reached the limestone at 92 feet. The distance separating these two borings is 1040 feet. Professor Kemp believes that a deep and relatively narrow gorge lies between. Several lines of wash borings at this place gave depths to supposed bed rock varying from 139.5 feet to 256 feet in what would perhaps be thought of as the deepest part of the river.

At New Hamburg the river is 2300 feet wide. Drill borings on each bank found the slate beneath the limestone. At the point of boring on the east bank it was reached at 220 feet; on the west at 351 feet. Only wash borings were made in the river bottom. These ranged from 130 feet to 263.5 feet below tide.

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[1] Buried Channels beneath the Hudson and its Tributaries. Amer. Jour. Sci. Ser. 4. 26:301–23.

At Danskammer the stream is about 3500 feet wide. The results of wash borings gave a range in depths from 133.2 feet to 268.5 feet to supposed rock bottom, but the evident irregularity and variability would seem to indicate a bed of loose material at these depths at this crossing.

At the Storm King crossing the drill brought up from a depth of 617.4 feet a core of granite just like that on the east bank of the river, which it had penetrated to a distance of 8.8 feet. The drill was thought to have reached rock bottom at this point at a depth of 608.6 feet not far from 750 feet from the east bank.

Casper creek was tested near its mouth by wash borings. The lowest point thus reached was 67 feet below tide.

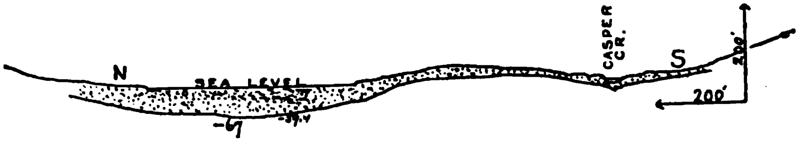

Fig. 28 The Casper creek crossing. (After Kemp)

In Wappinger creek one wash boring below the falls reached a depth of 50 feet below tide. Of three core borings, the maximum was 39 feet.

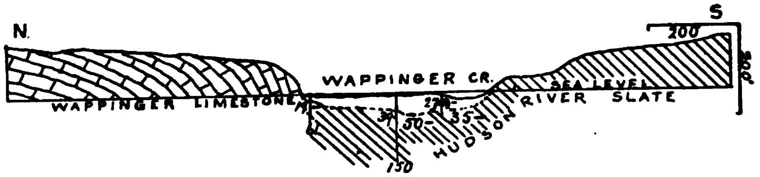

Fig. 29 The Wappinger creek crossing. (After. Kemp)

A proposed line of the aqueduct crossed Fishkill creek near the village of Fishkill. Everything is beneath the drift at this point. Of two core holes, the deeper reached the limestone at 40 feet below tide. After penetrating 8 feet of limestone, the drill encountered fine yellow sand in which it continued for 60 feet, when the hole was abandoned. This crossing is about five miles back from the Hudson.

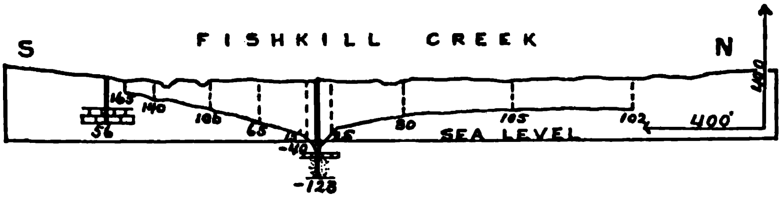

Fig. 30 The Fishkill creek crossing. (After Kemp)

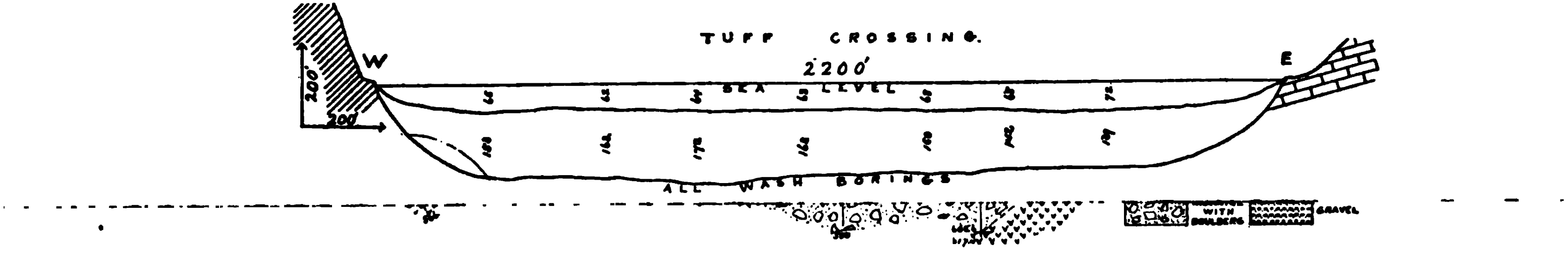

Fig. 27 Sections showing borings across the Hudson river at Tuff crossing, Peggs Point, New Hamburg, Danskammer and Storm King (after Kemp)

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The above-given numerals and description were taken from Professor Kemp's paper. The general conclusions to be drawn from these facts to which Professor Kemp has called attention, are that the Hudson river occupied a deep gorge at the close of the Tertiary period and that its tributaries emptied into it from hanging valleys. Unless a deep gorge exists at the Pegg's Point crossing, as discussed above, a rather large gradient between this point and Storm King would have to be assumed.

The borings south of Fishkill Village suggest that this creek deepened its gorge some distance back from the Hudson during late Tertiary time. The other tributaries probably did the same to an extent commensurate with their size and erosive power. All the tributaries, however, occupied hanging valleys with reference to the bed of the main stream.

The boring records also show that much glacial stuff now lies in these buried channels.

GLACIAL GEOLOGY

Erosion. The elevation of the land at the close of the Tertiary is believed by many to have ushered in the glacial epoch. The passage of the ice sheet over this region is marked by grooves and striae and characteristic deposits of surface material. The ice sheet may have assisted in gouging out the channel of the Hudson.

The following is a summary of observations by the writer on the direction of glacial striae and grooves in different parts of the quadrangle. West of the Hudson about two miles northwest of Highland, along the road to Lloyd, a deep glacial groove was noted with bearing true s. 15° w. One and a half miles west of Milton another fine groove gave a reading of true s. 9° w. Fine *roches moutonnees* occur to the west of "Illinois mountain" south of Lloyd.

East of the Hudson in the eastern part of the city of Poughkeepsie, near the driving park, striae were noted with bearing true s. about 14° w. and farther east, just west of the central strip of the Wappinger belt along the Hackensack road, a reading of true s. 1° w. was taken. Near the Central New England Railroad at Poughkeepsie the striae had a bearing of true s. about 26° w.; north of Poughkeepsie near quadrangle boundary, east of Fallkill creek, true s. 11° w.; one mile north of New Hackensack, n. 21° w.; near the Hudson, north of Fishkill Landing, true s. 33° w.

Some of the strike fault scarps, as, for instance, those of Bald hill, Mount Honness and Shenandoah mountain of the Highland spurs, and the fault east of Freedom Plains, appear to show the effects of glacial plucking.

The Highland crests were buried by the glacier. Some places along the northern slopes show polishing effects (see plate 6). The excavation of the valleys between the northern spurs of the Highlands was probably materially assisted by the ice.

Deposits during the advance. Drumlins, or drumlinoid masses of till, are rather numerous in the quadrangle and often are conspicuous features of the topography. They seem to be deposits of the advancing ice sheet which molded them by pressure into their usual elongated domelike shapes. These masses greatly obscure the structural relationships over much of the area. They are the most conspicuous features of the ground moraine. The larger part of the veneer of till, which is very plentiful, probably dates from the advance of the glacier. About 200 feet of boulders and sand, which rest on the bottom of the Hudson gorge, probably are a part of the ground moraine.

RETREAT OF THE ICE SHEET

It is generally held that accompanying and following the retreat of the Wisconsin ice sheet from this region there was a slow subsidence of the land. At this time a large body of water filled the old valley of the Hudson within this area. It would appear that the subsidence went on gradually and that during the earlier stages much sand, gravel and sandy clay was deposited on the earlier boulder material that covered the bed of the gorge to a depth of 200 feet, and then a thin layer of boulders representing a probable flood of floating ice, and then typical river deposits.[1] Finally, it would appear that the subsidence may have brought in estuarine conditions, at which time the Hudson river clays were laid down. These considerations assume an open gorge and postulate the probable deposition of the clays entirely across it, their present condition having been brought about by later dissection. It is proper to state that there are exceptions to this idea. Professor Woodworth, from a study of the entire Hudson and Champlain valleys, holds the opinion or belief that, during the deposition of these clays, the Hudson gorge was filled with a long tongue of ice against which were standing bodies of water at a higher level than water could have assumed in the open gorge. He cites many observations to show that the clays, and overlying sands and gravels are best explained as depositions under such conditions.[1] Woodworth's hypothesis does not call for so great a subsidence of the land as the other, and logically explains the present bisected character of the clays as their original condition. The proximity of the ice during the deposition of the so-called Champlain deposits is shown in several ways. It seems quite reasonable, however, to explain the upward more or less perfect passage from coarse to finer detritus in the Hudson gorge as due to gradual deepening, and a passage from fluviatile to estuarine conditions which would furnish the conditions for the accumulation of the finer material.

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[1] See J. F. Kemp. Buried Channels beneath the Hudson and its Tributaries. Amer. Jour. Sci. Ser. 4. 1908. 26:322.

Terraces. The finer material in question takes the form of stratified deposits of clay, capped with sand and gravel, which occur in the form of terraces at various places along the Hudson gorge. A number of these are in this quadrangle.

Such a terrace begins somewhat over a mile north of Fishkill Landing and extends for a mile north of that point, varying in width from about one-fifth to three-fourths of a mile. It is about 100 feet high at the outer edge and a few feet higher at the inner edge. It is followed on the north by a lower terrace varying from 30 to 40 feet in height, with varying depths of clay and covered with coarse gravel. On the west bank of the Hudson at Roseton and at Danskammer gravel-covered terraces also occur. These are somewhat higher than the north terrace on the east bank. Terrace deposits also occur at Marlboro.

At New Hamburg the deposits are a good deal coarser and have a terrace delta form. The coarse sands and gravels of this terrace and their general relations, as well as the Roseton and Danskammer terraces, are thought by Woodworth to " compel the belief " that they were deposited against the ice. In the case of the Roseton terrace, he states that there are signs of inthrusting of drift from ice movement (*loc. cit.* p. 119) and further that the terrace can not be attributed to a river pouring into an estuary after the disappearance of the ice.

The diminishing altitude of the terraces northward has been interpreted as favoring the idea of their formation against the ice in glacial lakes. The coarser material overlying the clays has been attributed to the retreat of the ice front beyond the mouths of tributary stream valleys, allowing an influx of coarser sediments.

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[1] Ancient Water Levels of the Champlain and Hudson Valleys. N. Y. State Mus. Bul. 84, 1905, p. 66–265.

By others, the lower level at the north has been attributed to erosion accompanying elevation, and the coarser sediments to the same cause.

C. E. Peet[1] has made the observation that, if the valley between the low terrace just south and north of Carthage Landing and the slightly higher one on the west of the river at Roseton and Danskammer were filled with ice, the latter was stagnant, and may have stood on the lower terrace at the east. He also admits the possibility that the terraces may have been continuous and that the lower one on the east is the product of the erosion of higher deposits.

Later, in discussing the history of the "Hudson water body and the successive positions of the ice as it retreated through the Hudson valley, Peet[2] states that the ice front appears to have assumed two distinct phases in different parts of the valley. In some parts, notably the narrower ones, it is believed that the ice protruded down the valley and that accumulations took place at the edge of this ice-tongue, or between it and the valley wall. The deposits at Carthage Landing and New Hamburg might represent such conditions, but the valley ice was probably not an active contributor, although at the latter place waters from the valley ice may have been active in the early stages of the plateau building. In the broader parts of the valley the deposits were probably deposited in an embayment of the ice front.

Peet cites many facts to show that the Hudson water body may have been a lake made by a barrier at the south, or a succession of lakes made by a succession of barriers or by a migrating barrier, and, on the whole, leans toward the lake hypothesis as against a salt water body. The reader is referred to the original paper (see *loc. cit.* p. 640–56).

It is probable that a series of glacial lacustrine basins at the south would have allowed both for open water and the many characteristic glacial phenomena in connection with the deposition of this material.

On the submergence hypothesis an elevation of between 100 and 150 feet was necessary for the bisection of the delta at New Hamburg, and at this time the deposits in the gorge of the Hudson may have been dissected, although to a greater extent in the case of the main river. The moot point seems to be the extent to which the gorge was submerged by the sea.

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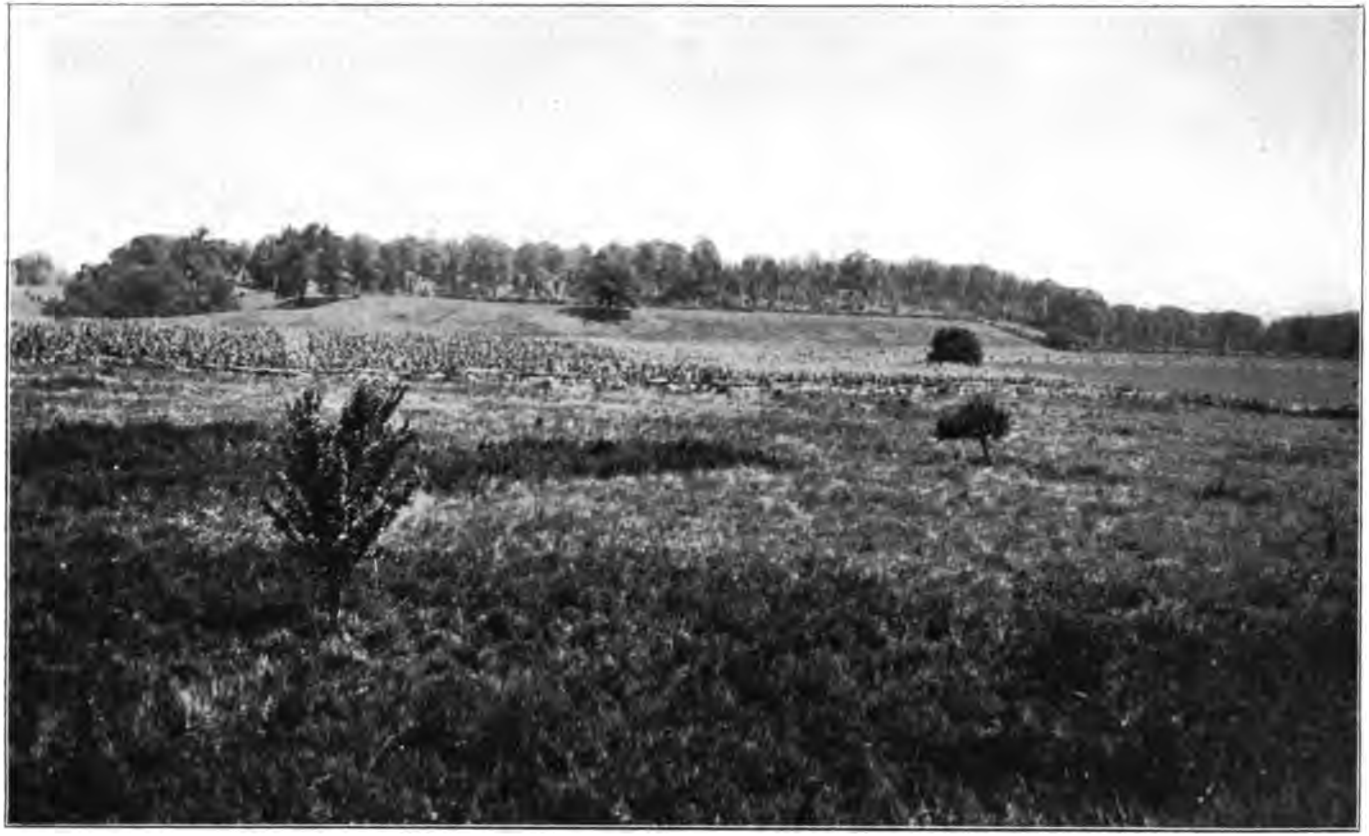
[1] Journal of Geology. 12:445.

[2] *loc. cit.*, p. 618–21.

Plate 20



A portion of the high-level terrace of Wappinger creek near Tompkins's farm, east of the road from Poughkeepsie to Pleasant Valley

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Well-preserved sand and gravel erosion terraces occur at frequent intervals along Wappinger creek. These are best shown in the open portion of the valley of this stream in the neighborhood of Manchester Bridge and between that hamlet and Rochdale. The road from Manchester Bridge to Rochdale for a mile north of the former place closely follows the edge of a fine terrace that drops with uniform slope from the 160 foot level to the present flood plain of the creek. The cemetery at Manchester Bridge is built on a projecting tongue of this fine terrace which is broken by the limestone knoll on which Mr George Byer's house stands. North of here it may be followed for a short distance.

South of Rochdale, to the east of the Pleasant Valley road, on the west side of the creek, the present flood plain makes a large embayment to the west, north of Frank De Garmo's house. This embayment is fringed by a fine terrace, a portion of which is shown in plate 20. Other terrace remnants may be followed southward along the creek.

These dissected deposits clearly belong to an epoch when the creek valley was flooded and the creek was able to aggrade its valley floor to the level of these terraces, at least. It was probably during this time that the delta deposits were making at the mouth of the creek, whatever the conditions there may have been. These features would appear to have been intimately connected with the retreat of the ice sheet which, as it melted, would have furnished both the floods and the material. This material is in the form of sand and gravel. A good deal of finer detritus must have been carried out into the Hudson gorge.

To allow for this accumulation of sand and gravel in the old valley of the creek, either there must have been a body of standing water in the Hudson gorge nearly 200 feet higher than now, or the land must have been much lower than now.

Fishkill creek and its tributaries were also able to aggrade their valley floors. Gravel deposits belonging to a former higher level form imperfect terraces at different points. In some places, the gravels look like outwash plains during a short halting of the ice, as in the vicinity of Hopewell Junction. The Newburgh, Dutchess & Connecticut Railroad apparently cuts a series of terrace remnants from Hopewell to Brinckerhoff. Fishkill Village is located on a terrace at the 200 foot level which extends southwest to Glenham. Small, but perfect, terrace levels along brooks tributary to Fishkill creek, belonging to a stage in the subsidence of the water corresponding to the rock barrier over which the main stream flowed at Glenham, are preserved near Johnsville.

Kame deposits. These are prominently developed in places along the northern margin of the Fishkill mountains. A conspicuous group occurs along the Cold Spring road south of Fishkill Village, near the quadrangle boundary.

Kame moraine deposits are prominently developed south of Johnsville along the eastern base of Mount Honness, and still farther south along the western road from West Fishkill Hook into the mountains.

The brook flowing north from the mountains, through the hollow of East Fishkill Hook, cuts through similar masses.

Kames are noticeable features along the road from East Fishkill Hook to Shenandoah. Northeast and east of that hamlet they are pronounced topographic forms guarding the approach to Shenandoah hollow (see plate 21).

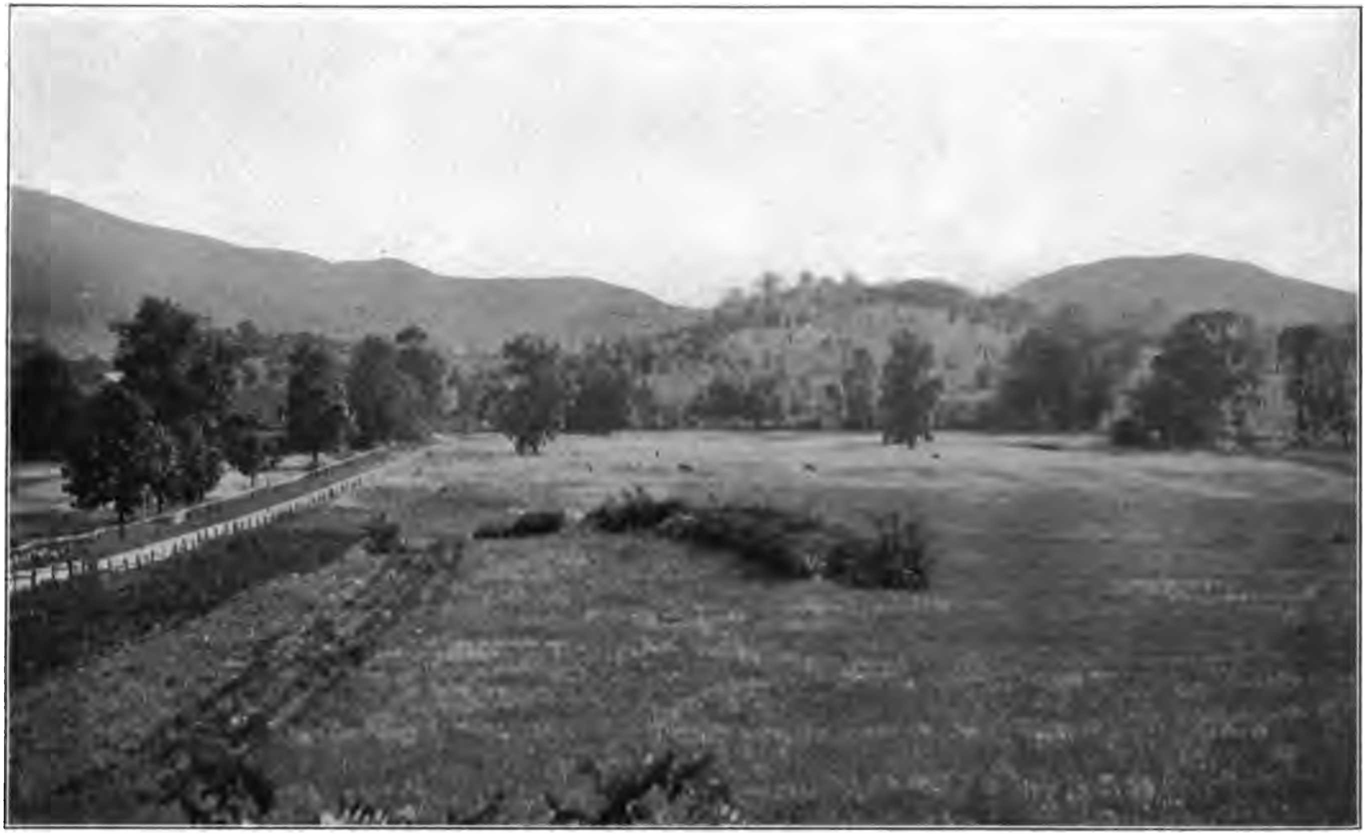
Kames also occur along Casper creek between the Hudson river and the Poughkeepsie road (see plate 22), and near Camelot.

POSTGLACIAL EROSION

After the retreat of the glacier either the land, which probably was at a higher level than now, remained stationary, while the water level in the gorge subsided, or it was elevated. The tributary streams, now greatly reduced in volume, meandered over their old flood plains and began the vertical and lateral dissection recorded in part by the terraces described or alluded to above. Wappinger creek, in seeking an outlet to the Hudson, was confined near its mouth between narrower rock walls and began the bisection of its old delta of the flood period. It readily found its old preglacial channel, which it tumbles into at Wappinger Falls. The precipice at this place forms a local base-level to which the stream is slowly reducing its bed at various places along its course at the north.

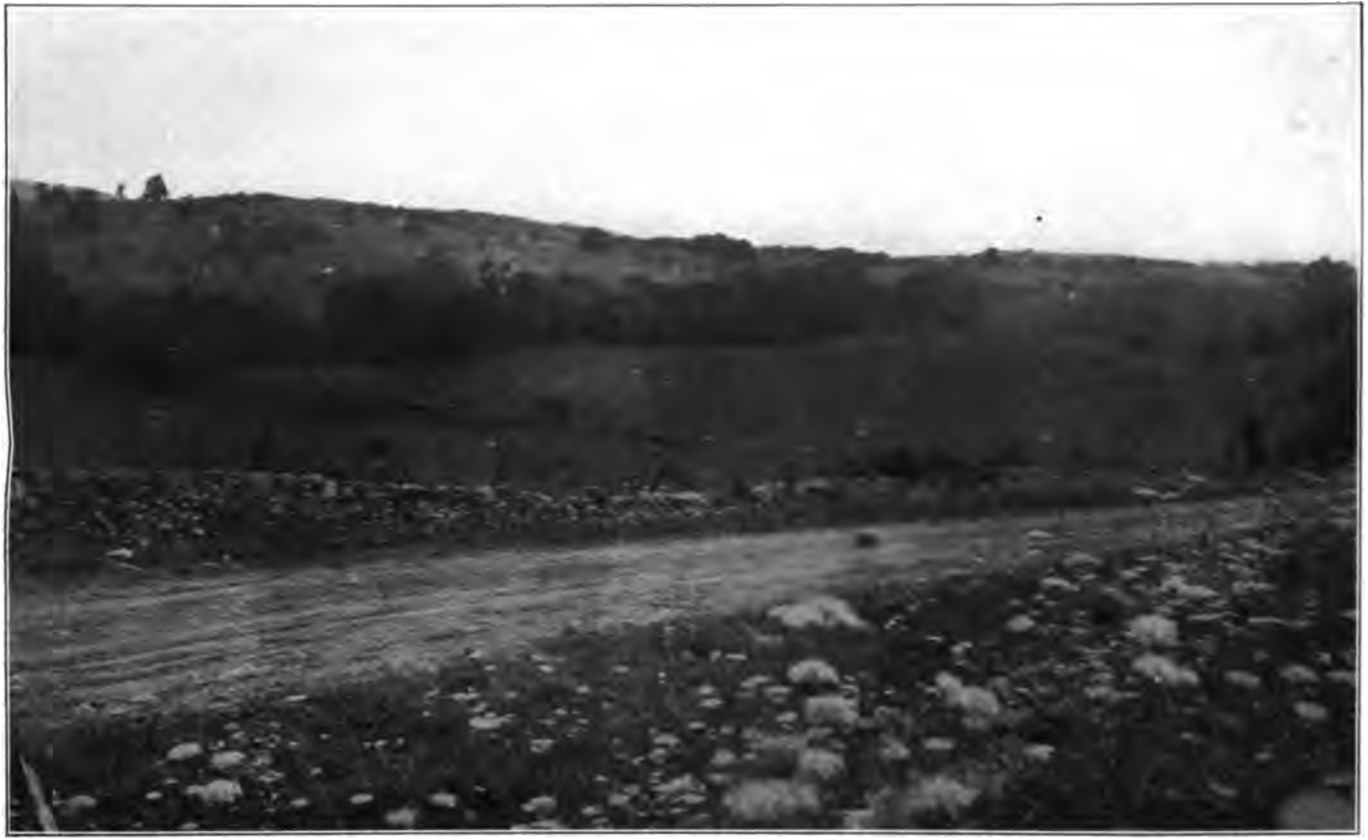
Fishkill creek is off its old preglacial channel for some distance in Glenham and between that hamlet and Matteawan. When the stream was superposed on its former flood plain it was obliged to make a wide detour at Glenham round the huge drumlin on which the cemetery of Matteawan stands. It eventually found bed rock and finally the contact between the limestone and the gneiss of the Glenham belt, and has made the gorge shown in plate 23. At the northeast end of the carpet mill the creek crosses a fault between

Plate 21



Kames northeast of Shenandoah at the northern opening of Shenandoah hollow. Shenandoah mountain may be seen in the background on the right of the picture

Plate 22



Kames along Casper creek west of the road from Wappinger Falls to Poughkeepsie

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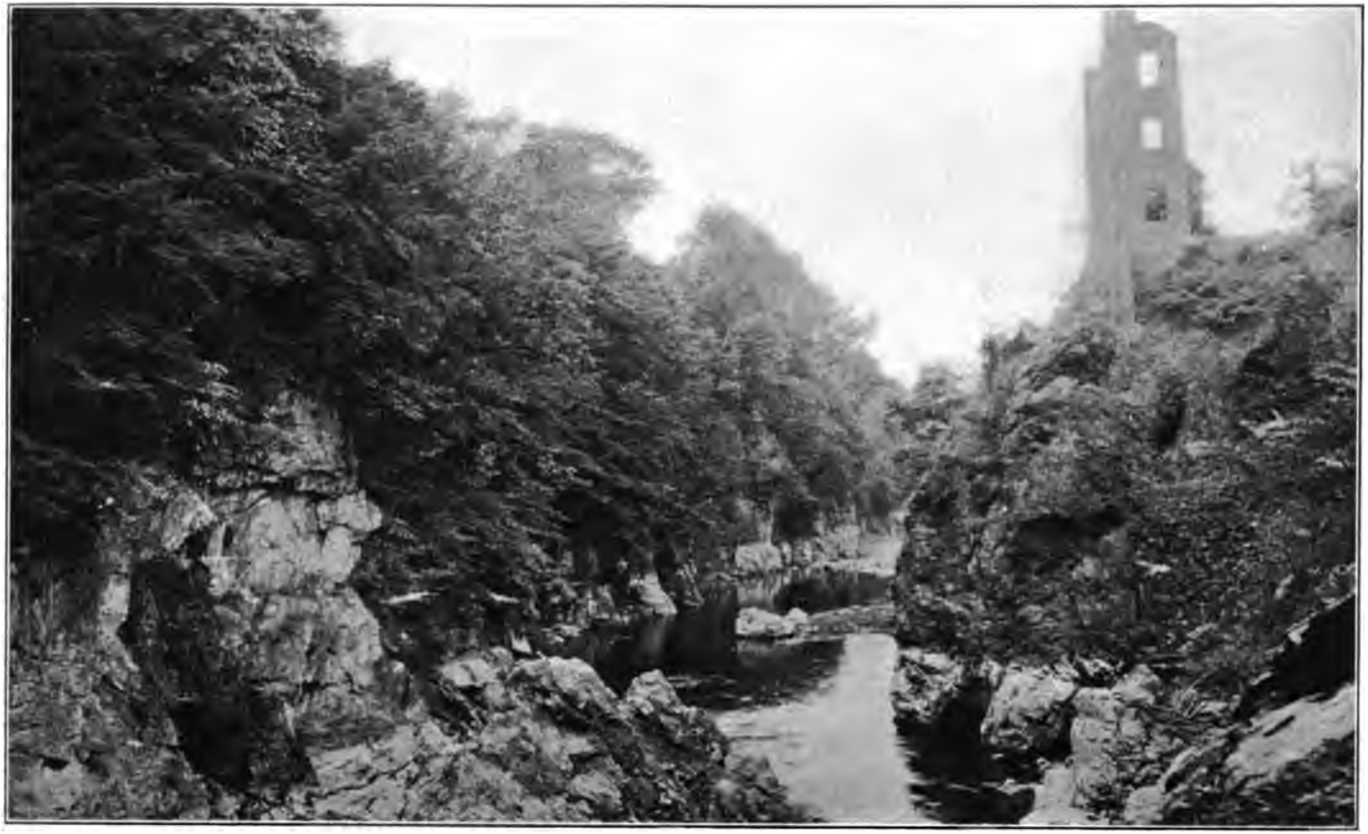
Plate 23



Postglacial gorge of Fishkill creek below the railroad bridge at Glenham. Gneiss forms the right wall and limestone the left

the limestone and the slate and from this point on cascades over the slates until its own delta is reached. It is probably along or very near its preglacial channel from Wolcott avenue southward. The preglacial channel north of here is probably to the southeast of the present course of the stream.

It may be that during this time of erosion the Hudson cut its present gorge and that the gravel-covered, laminated clays are erosion terraces instead of benches laid down against the ice.

THE PRESENT DEPRESSION

Following the bisection of the Wappinger creek delta, the valley of the Hudson suffered the depression that produced the present estuary and the later channel of Wappinger creek was submerged (see plate 24). Fishkill creek filled up its gorge to tide level and produced its present delta.

OTHER DRAINAGE FEATURES AND ADJUSTMENTS

Near Gregory's mill at Old Hopewell, Fishkill creek was deflected by the drift and imposed on the limestone through which it has cut a gorge.

The rock valley of Casper creek, at points north of the Hopewell branch of the Central New England Railroad, suggests a once more powerful stream which may have drained a larger area to the north of this quadrangle along the valley of the brook that rises in the swamp east of Van Wagner, and now flows north to join a southward flowing stream of considerable size, and which reaches Wappinger creek by making an abrupt turn to the east-northeast.

The course of the Fallkill near Poughkeepsie suggests that this stream has utilized certain fault features. Fishkill creek, along its course within the quadrangle, makes a number of bends to the northeast that are in line with the fault features of the Fishkill limestone.

LAND FORMS

These are apparently of two fundamental types: those produced by a sort of block faulting and those produced by folding, accompanied by faulting. Each is distinct, but is modified by the other. Both apparently date from the time of the Green mountain revolution.

At the close of Cretacic time this region was a peneplain. A re-elevation introduced the history of the present topographic aspect of the quadrangle and subsequent erosion presents the striking discordance between the present topography and relations and those of Precambric and early Paleozoic time.

The Precambric gneissic floor appears to have behaved in a measure as though it had no load. It was twisted and broken into blocks like a piece of glass and thrust up into the overlying formations, the force of the shove diminishing to the northwest. The plateau type of the Highlands is primarily the result of upward thrust as a mass and secondarily the effect of the resistant quality of the Precambric rocks when subjected to erosion. The present topographic level of the Fishkill limestone would appear to indicate a normal position for the limestone now. Primarily, however, it is a faulted up thrust block; erosion has exposed the older stratigraphic series which were thrust up into the overlying slates.

The northern valleys of the Highlands represent down-faulted masses of the younger rocks which later erosion cycles discovered and removed.

As superstructures on these basal features are forms connected with folding and breaks along the strike and dip.

Influence of the petrographic character of the rock. The low average level of the Hudson valley is attributable to the ease with which the slates are broken up and removed. The relatively low topographic level of the Fishkill limestone, corresponding with its lower stratigraphic position, is deceptive. In this case, the removal of the slates and the erosion of the limestone obscures the structural position brought about by faulting.

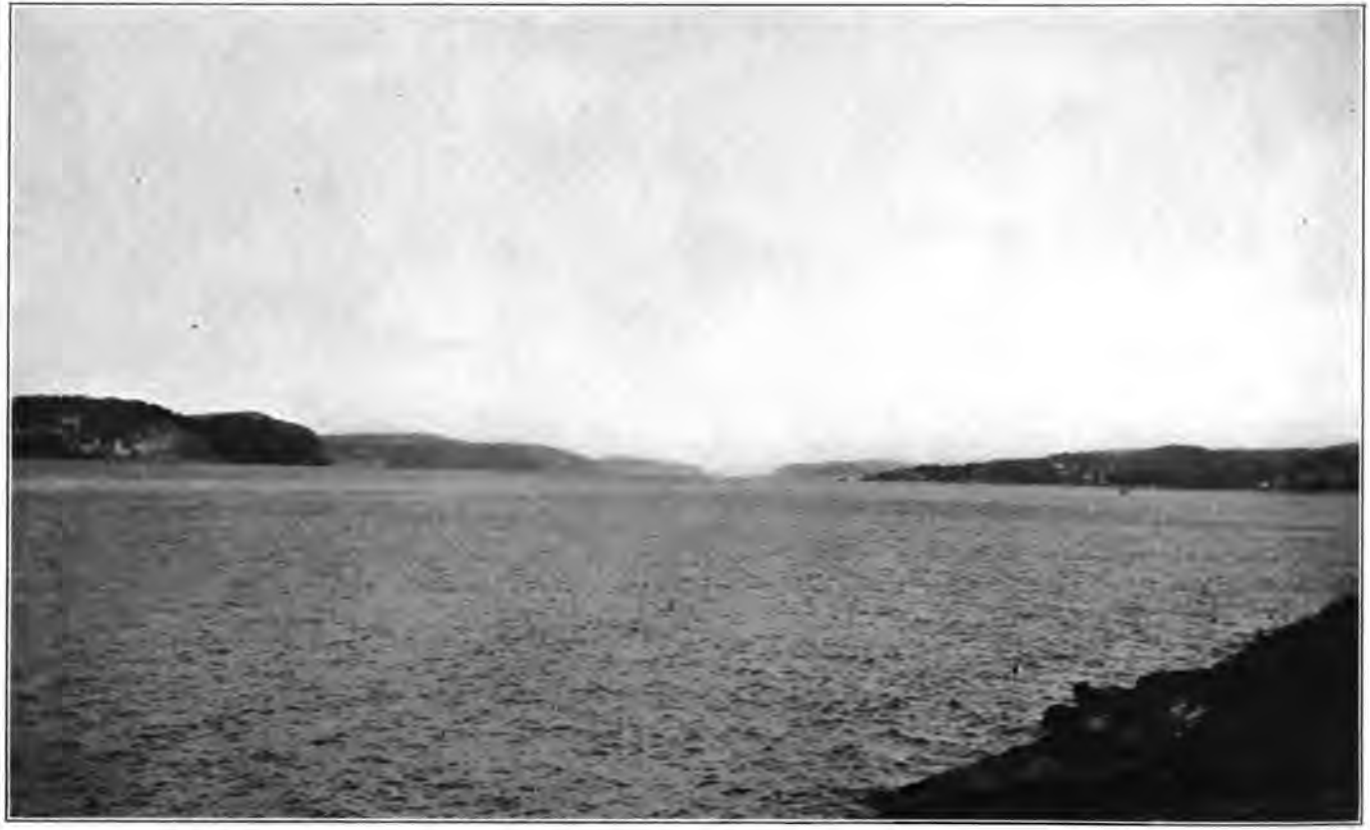
The present altitude of the high ridge forming " Illinois mountain " is due in part to the resistant character of its grits.

The resistant quality of the metamorphosed rocks in the eastern part of the quadrangle has been a factor in producing their present relief.

ECONOMIC GEOLOGY

The agricultural industry. The agricultural interests are chiefly those of fruit growing and dairy farming. The former is conducted on an intensive plan on the hilly land west of the Hudson where well-drained hills of tilted slates, covered with a veneer of till and coarse gravel, afford highly suitable soil conditions for growing fruit of excellent quality. Large consignments of peaches, apples, pears and small fruit are sent to New York city and New England markets and some growers find a highly profitable business for fancy fruit in the markets of England. Grapes are also a successful and important crop.

Plate 24



Drowned gorge of the Hudson as seen two miles south of New Hamburg, looking north

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Fruit growing is also practised east of the Hudson. Nearly every large farm has its apple orchard, some of which are of large size. Peaches are also successfully grown and apparently are growing in popularity as an investment. Some fine fruit is grown in small orchards along the northern slopes of the Fishkill mountains. The Hudson river affords favorable temperature conditions for the budding season and insures good crops. The ravages of the coddling moth and other injurious insects are, however, sometimes extensive.

The importance of the climatic influence of the Hudson river as a successful factor in fruit growing is clearly recognized. Fruit is not so successfully grown out of reach of this influence, even on soils of the same character and with similar drainage.

Dairying is perhaps the largest farming industry and the one most widely practised. The area enjoys unusual facilities for transportation of farm products.

Soils. The glacial ice, as shown above, moved in a course generally roughly parallel with the longer axes of the rock ridges. This fact seems to have had an influence on the character of the soil along these ridges. It is noticeable that the upland soils have a definite relation to the underlying rock.

Lower levels, which mark the flood epoch of the waning ice sheet, have sandy and gravelly soils, with clayey subsoils, and are often of terrace form or in kamelike masses. In addition to these are the drumlinoid masses of somewhat more compacted character, often attaining or approximating boulder till. Finally, there are the alluviums of the river bottoms.

The limestone areas are considered the finest grass lands, but all the upland soils yield good grass crops. The gravelly river bottoms are usually good corn soils. The more sandy terrace soils are suitable for garden truck or early fruit. The slaty hill sides usually give good apple-growing soils when not too clayey.

The finest farms are in the limestone areas, but the slaty uplands of moderate elevation are highly valued for both of the principal farming pursuits of the present day.

Clays. All the important clays of this area are of sedimentary character and belong to Pleistocene time.

A number of important brick industries are located within the quadrangle. The laminated clays that have been briefly described as forming the terraces along the Hudson, between Fishkill Landing and New Hamburg, and on the west bank at Roseton and Danskammer, are worked on extensive scales (see plates 25 and 26).

These beds form only a part, but are perhaps as important as any, of the valued clays of the Hudson valley.

These deposits are very similar in appearance. The lower portions are usually bluish and the upper yellowish in color. The laminated character is best shown in the upper layers. Thin laminae of sand occasionally appear, in some places forming such proportion of the masses as to require no admixtures of that material in the process of brick manufacture. The coarser sandy material overlying the clay, when screened, furnishes sufficient quantities of sand when that is required, which is usually the case on account of the purity of the clay.

The chemical composition of the clay at Roseton is given from the following analysis:[1]

SiO_2	55.00
Al_2O_3 Fe_2O_3	34.54
CaO	5.33
MgO	3.43
K_2O Na_2O	0.48
Combined H_2O Moisture	1.22
	100.00

Both the blue and yellow clays are calcareous and effervesce with acid. They have been used as marls on account of their lime content. The yellow color is due to oxidation. The clays are used entirely for brick.

Clay deposits also occur at Arlington, a mile east of Poughkeepsie, and are used for brick. The clay which is fairly abundant along the banks of Casper creek in the neighborhood of Arlington is covered with some sod, but is easily exposed by stripping this off. Yellow clay is underlain by blue clay.

It seems possible that the deposits at Arlington were accumulated in lacustrine waters, perhaps impounded by stagnant ice at the mouth of Casper creek. The kames (see plate 21) that now lie near the mouth of the creek may have been left by the melting of such a mass of ice.

Limestone quarries. Quarries have been opened at places in the limestone strips of the Wappinger creek belt. The largest of these is Stoneco quarry, operated by the Clinton Point Stone Com-

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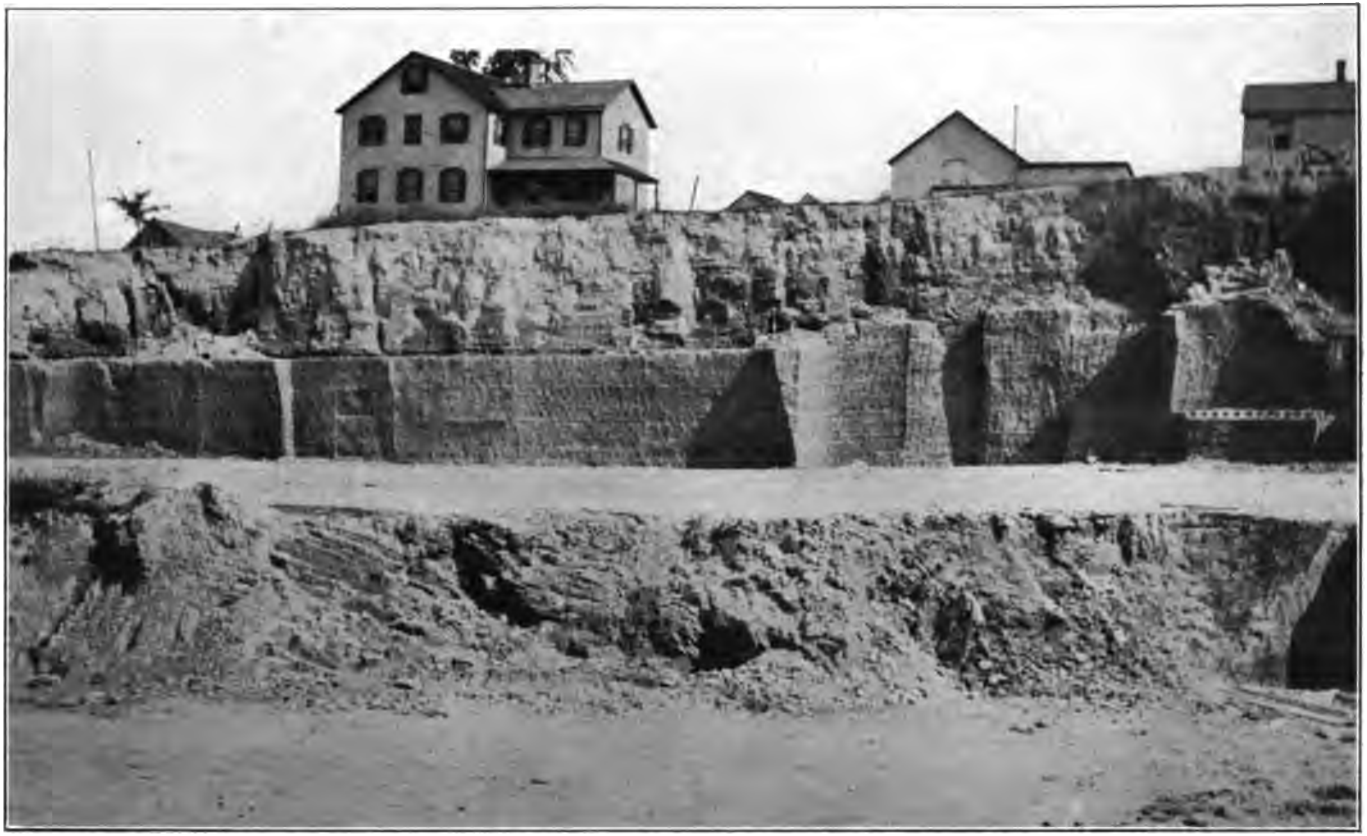
[1] Ries, N. Y. State Mus. Bul. 35, 1906, p. 381.

Plate 25



Laminated clays in the pits at J. Paye's brickyard, north of Fishkill Landing. Thephotograph also shows joint structure in the clays is known as Fowler's kaolin mine. The material at present is taken out on a small scale and sold principally for stove cement.

Molding sands. Molding sand is dug in large quantities a short distance back from the Hudson, near the mouth of Casper creek and two miles north of that place, and is hauled to docks at these places for shipment.

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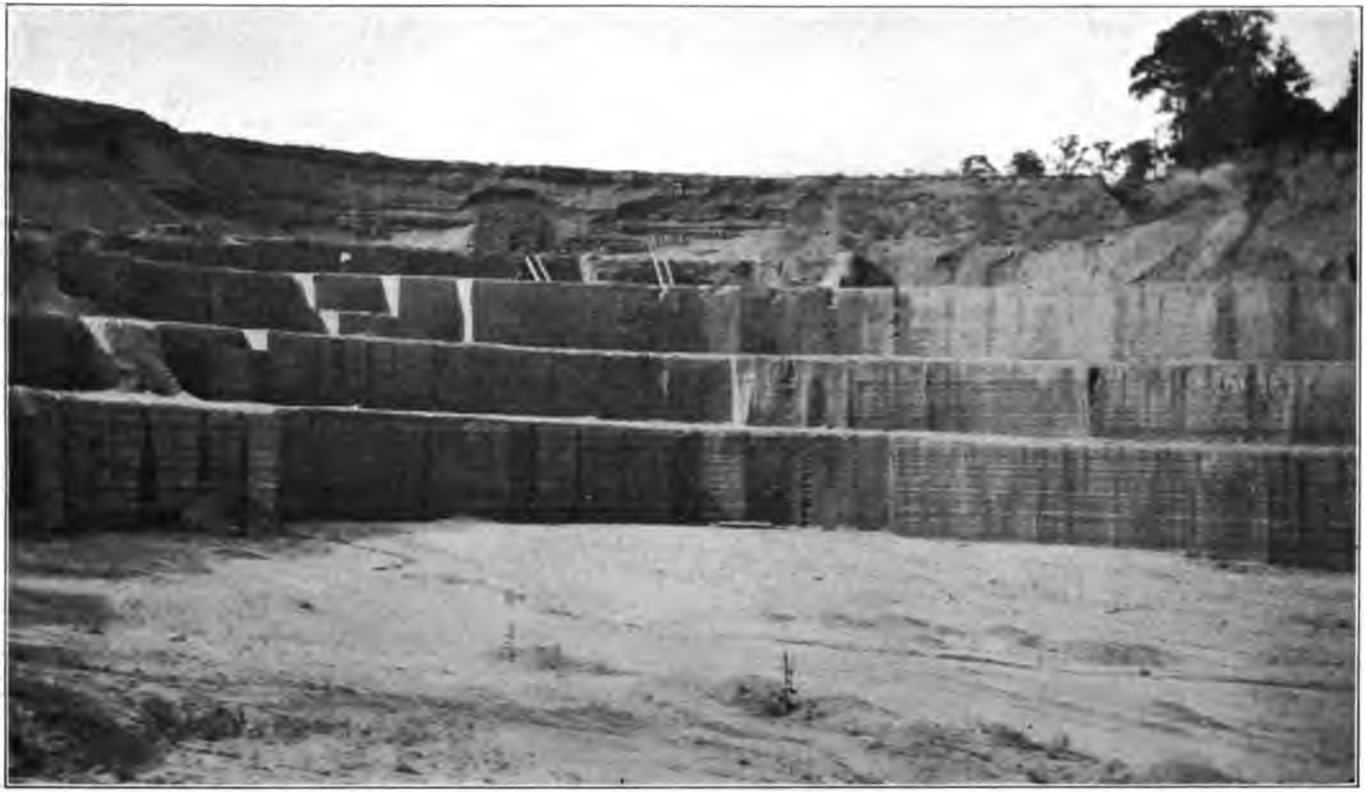
Plate 26



Showing the laminated clays and overlying gravel in the pits at Roseton

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is known as Fowler's kaolin mine. The material at present is taken out on a small scale and sold principally for stove cement.

Molding sands. Molding sand is dug in large quantities a short distance back from the Hudson, near the mouth of Casper creek and two miles north of that place, and is hauled to docks at these places for shipment.

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